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Geology of the

Quest Lake Area

Districts of Kenora and Thunder Bay

By

N. F. Trowell

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GEOLOGICAL MAP

(back pocket)

Map 2335 (coloured)–Quest Lake, Districts of Kenora and Thunder Bay.
Scale 1 inch to ½ mile or 1:31,680.

ABSTRACT

The Quest Lake area comprises approximately 300 km² (115 square miles) and is bounded by Longitudes 90°36′W and 90°59′W and Latitudes 49°54′N and 50°00′N.

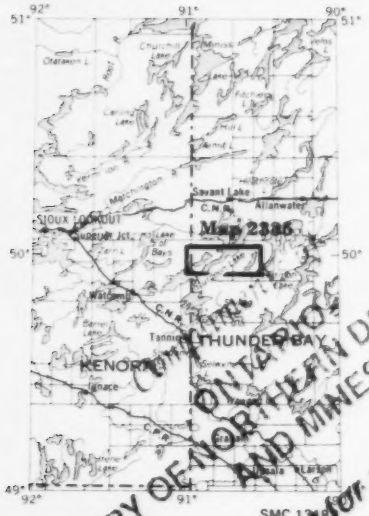

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Figure 1–Key map showing location of Quest Lake map-area.
Scale 1 inch to 50 miles (1:3,168,000).

Rocks of Early Precambrian (Archean) and possibly Middle Precambrian age (Sturgeon Narrows Alkalic Complex) underlie the map-area and are overlain by unconsolidated Quaternary glacial and glaciofluvial deposits. Early Precambrian rocks include mafic to intermediate and felsic to intermediate metavolcanics, metasediments, mafic and ultramafic intrusive rocks, and felsic to intermediate intrusive rocks. An alkalic intrusive complex is possibly of Middle Precambrian age, but is shown on the map as Early Precambrian because no radiometric ages are available.

Divergent structural trends and the presence of small scale fold structures indicate that the rocks of the area have been folded. The regional trend changes from approximately east in the western portion of the map-area to the northeast and north in the eastern portion. Only minor faulting was recognized though Sturgeon Narrows may mark a major zone of structural disturbance.

The Sturgeon Lake area, of which this map-area comprises a portion, is of course now known for its massive base-metal sulphide deposits. Within the immediate map-area, mineral exploration has revealed the presence of minor fluorite and sulphide mineralization, but no definite indications of economic mineralization are yet known.

Geology
of the
Quest Lake Area
Districts of Kenora and Thunder Bay

by

N.F. Trowell[1]

INTRODUCTION

In 1968, the author began a mapping program of the Sturgeon Lake meta-volcanic-metasedimentary belt. In 1968, the Watcomb area was mapped (*see* Trowell 1970), in 1969 the Bell Lake–Sturgeon Lake area (*see* Trowell 1974a), in 1970, the Glitter Lake area (*see* Trowell 1974b) and in 1971 the present Quest Lake area was mapped.

The Quest Lake map-area is situated 87 km (54 miles) northeast of Ignace. The area straddles the Kenora–Thunder Bay District boundary and falls within the Patricia Mining Division. The west limit overlaps the east boundary of the Bell Lake–Sturgeon Lake area (Trowell 1974a), and the south limit adjoins the north boundary of the Glitter Lake area (Trowell 1974b).

The map-area covers approximately 300 km^2 (115 square miles). It is bounded by Latitudes 49°54′ to 50°00′N and Longitudes 90°36′ to 90°59′W. The western and central portions of the area are accessible by Sturgeon Lake, and the eastern portion can be reached by float-equipped aircraft or portage trails from Sturgeon Lake to the Barge-Post-Add chain of lakes and to Princess and Quest Lakes. Vista Lake can be reached by a short portage from Quest Lake. Highway 599 which extends northeast from Ignace, and lies to the west of the immediate map-area, provides access to Sturgeon Lake.

Present Geological Survey

Geological mapping was done at a scale of 1 inch to ¼ mile (1:15,840) for publication at 1 inch to ½ mile (1:31,680). Air photographs were supplied by the Air Photo Library, Ontario Ministry of Natural Resources; cronaflex base-maps were prepared by the Cartographic Section, Ontario Division of Lands.

Traverses were spaced at 300 to 450 m (1,000 to 1,500 feet) intervals. Outcrop locations were determined from pace-and-compass measurements, and tied

[1]Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Toronto. Manuscript accepted for publication by the Chief Geologist, December 2, 1974.

into recognizable features on the base-maps and air photographs.

Air photographs alone were of little use in locating outcrops owing to a thick cover of overburden and vegetation. For this reason, generalized outcrop areas rather than specific outcrop exposures are shown on Map 2335 (back pocket). Information from property plans and diamond-drill hole logs filed in the Assessment Files Research Office, Ontario Division of Mines, Toronto, and ODM-GSC aeromagnetic map 1117G (ODM-GSC 1961) were also used in the preparation of this report.

Two preliminary maps were previously released (Trowell 1972a; 1972b).

Acknowledgments

The author was assisted in the field by Robert Belanger, C.C. Storey, Bert Killins, R.C. Lelièvre and L.G. Stephenson. Mr. Belanger and Mr. Stephenson, as senior assistants were responsible for part of the mapping.

Chemical and X-ray analyses were done by the staff of the Mineral Research Branch, Ontario Division of Mines. The author wishes to thank the exploration staff of Rio Tinto Canadian Exploration Limited, especially Mr. C.D. Spence and Mr. Wayne Benham for their co-operation on this project, specifically in providing the author with detailed geological maps of the Six Mile Lake area. Dr. D.H. Watkinson of the Department of Geology, Carleton University, Ottawa, did an electron microprobe study which was extremely useful to the author.

Prospecting and Mining Activity

Until 1969-1970 the area had been only intermittently prospected since gold was first discovered in the Sturgeon Lake area in 1898 (McInnes 1900). Since the discovery in October, 1969, of a base metal (Zn, Cu, Ag, Pb) sulphide deposit (Mattabi Mines Limited) by the Exploration Division of Mattagami Lake Mines Limited, the entire district has, and is being extensively prospected. Mattabi Mines Limited is mining the above deposit, which is located south of Sturgeon Lake at the boundary line between the Districts of Kenora and Thunder Bay. Production commenced in 1972. Further discoveries have stimulated exploration in the area. Important Zn-Cu-Ag-(Pb) mineralization was discovered in 1970 by Falconbridge Nickel Mines Limited on the property they had optioned from New Brunswick Uranium Metals and Mining Limited located south of Lyon Lake, and in 1971 by Mattagami Lake Mines Limited near Lyon Lake, north of the Falconbridge Nickel Mines Limited discovery.

Except for those areas underlain by felsic to intermediate intrusive rocks and some areas underlain by metasediments, almost the entire Quest Lake area has been staked. Exploration programs involving geological and geophysical surveys and diamond drilling have been undertaken by several companies on their respective properties.

Previous Geological Work

W. McInnes of the Geological Survey of Canada (1900, p.118-120) was the first geologist to describe the geology of the Sturgeon Lake region. A.P. Coleman (1902, p.147-149), W.G. Miller (1903,p.83-86), W.H. Collins (1907, p.103-109), and E.T. Corkill (1908, p.64-65; 1909, p.81-92; 1910, p.79) gave brief accounts of the general geology, gold prospects, and mines in the Sturgeon Lake area. E.S. Moore (1911), T.L. Gledhill(1924), and A.R. Graham (1930) gave fairly detailed descriptions of the Sturgeon Lake region. H.C. Horwood (1937), T.L. Tanton (1940) and D.P. Rogers (1964) all carried out regional geological surveys covering various portions of the Sturgeon Lake metavolcanic-metasedimentary belt.

Renewable Natural Resources

Trees found in the area include jackpine, spruce, poplar, balsam and alder. Cedar and alder are prominent in the swamp areas.

While no trees are harvested at present, parts of the Quest Lake area have been cut over, specifically the areas north of Barge and Post Lakes and south of Sturgeon Lake.

The Sturgeon Lake area has long been a major tourist area and several lodges and tourist camps are present within the area. Northern pike, pickerel, and lake trout are commonly caught. Moose and bear are hunted in season, and fur-bearing animals are trapped in the general Sturgeon Lake–Savant Lake area.

Physiography

The elevation of Sturgeon Lake is 409.0 m (1,342 feet) above sea level, and the maximum local relief is not more than 60 m (200 feet) above this elevation.

The relief mainly reflects the distribution of the Pleistocene and Recent deposits, specifically moraines and northeast- to north-trending esker-outwash complexes.

Along Sturgeon Narrows local relief reflects presumed fault scarps on the west side of the narrows and the Sturgeon Narrows Alkalic Complex on the east side.

The map-area lies in the drainage basins of the English River, and its tributary, the Sturgeon River. The entire region has been glaciated and the lakes occur both in erosional basins in the underlying bedrock, subsequently deepened by glacial action, and in shallow basins in the glacial deposits themselves.

Outcrop density is moderate to low due to a thick cover of overburden. The outcrop exposures are generally small and moss-covered. Outcrop exposures on lakes shores are generally bare but these also are not abundant.

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE QUEST LAKE AREA

CENOZOIC
Quaternary
RECENT
Swamp, lake, and stream deposits

PLEISTOCENE
Glacial and glaciofluvial deposits

Unconformity

PRECAMBRIAN
EARLY PRECAMBRIAN (ARCHEAN)
Felsic Intrusive Rocks
STURGEON NARROWS ALKALIC COMPLEX
Syenite, nepheline syenite, muscovite syenite, garnet-nepheline syenite, syenogabbro, syenodiorite, feldspathic and lamprophyre dikes

VISTA LAKE COMPLEX
Syenite, syenodiorite, monzonite, quartz monzonite

SAUNDERS LAKE PLUTON
Granite, granodiorite

PORPHYRITIC INTRUSIVE ROCKS
Quartz porphyry, quartz-feldspar porphyry, feldspar porphyry

Intrusive Contact

Mafic and Ultramafic Intrusive Rocks
Metagabbro, metadiorite, peridotite

Intrusive Contact

Metavolcanics and Metasediments
METASEDIMENTS
Greywacke, siltstone, argillite, conglomerate, metasedimentary schists and gneisses

FELSIC TO INTERMEDIATE METAVOLCANICS
Pyroclastic and volcanic clastic rocks, autoclastic breccia, possible felsic to intermediate flows

MAFIC TO INTERMEDIATE METAVOLCANICS
Fine-to coarse-grained flows, porphyritic flows, pillowed flows, amygdaloidal flows, pyroclastic and other fragmental rocks, chlorite schist, metadiabase

GENERAL GEOLOGY

The entire map-area is underlain by Precambrian rocks which are extensively overlain by glacial deposits and by Recent swamp accumulations.

The northwest portion of the area is underlain by a succession of metavolcanics which has been extensively intruded by metagabbro, metadiorite and various felsic to intermediate porphyries. A second succession of metavolcanics occurs in the central portion of the area, east of Sturgeon Narrows and north of the Barge-Post-Add[1] chain of lakes. Four ultramafic bodies of serpentinized peridotite as well as minor metagabbro and metadiorite occur in this succession. Metasediments occur in four areas: along the approximate centre of Sturgeon Lake; along the Barge-Post-Add chain of lakes; along Sturgeon Narrows; and on the shore and east of Quest and Princess Lakes.

The Saunders Lake Pluton and Vista Lake Complex have intruded the metavolcanic-metasedimentary sequence. They are exposed in the northwestern and eastern portions of the map-area respectively. Porphyritic intrusive rocks associated both with the metavolcanics and the felsic intrusive rocks intrude the several metavolcanic and metasedimentary assemblages in the map-area.

The Sturgeon Narrows Alkalic Complex, exposed along and east of Sturgeon Narrows, has intruded the metavolcanics and metasediments. A narrow zone of fenitization along the contact zone has locally developed in the metavolcanics and metasediments.

Early Precambrian (Archean)

METAVOLCANICS AND METASEDIMENTS

Mafic to Intermediate Metavolcanics

Mafic to intermediate metavolcanics occur in three general areas: between Sturgeon Lake and Six Mile Lake; on the south shore of and south of Sturgeon Lake, and in an area confined by Barge and Post Lakes to the south, Sturgeon Narrows to the west and north, and Princess and Quest Lakes to the east. Thin mafic interflows are locally present north of Six Mile Lake in the felsic to intermediate metavolcanic–mafic intrusive assemblage. As mentioned under 'Mafic and Ultramafic Intrusive Rocks' it is difficult with limited outcrop exposure to distinguish between mafic intrusive rocks and medium-grained to coarse-grained flows and flow centres.

All of the mafic to intermediate metavolcanics have been metamorphosed under greenschist facies conditions. In thin section their mineralogical assemblages are seen to be: plagioclase (albite-oligoclase) ± amphibole (tremolite-acti-

[1] Add Lake is south of the Quest Lake map-area.

onlite series) ± chlorite ± epidote ± carbonate ± opaque oxides ± pyrite. Plagioclase and the mafic minerals generally constitute 80 percent of these rocks. The plagioclase grains are invariably moderately to completely altered to saussurite or sericite. Quartz is present in amounts ranging from 0 to 10 percent; it is generally anhedral to subhedral and occupies an interstitial position. Carbonate content is quite variable although the more highly sheared units appear to contain the greatest amount. Pyrite is ubiquitous (0.5 to 2 percent) in the mafic to intermediate metavolcanics; locally it is accompanied by minor pyrrhotite and chalcopyrite.

Partial chemical analyses (not given) of three grab samples of mafic to intermediate metavolcanics collected on the shore and south of Sturgeon Lake are characteristic of (tholeiitic?) basalts (analyses by Mineral Research Branch, Ontario Division of Mines).

STURGEON LAKE–SIX MILE LAKE AREA

The mafic to intermediate metavolcanic succession which is exposed between Six Mile and Sturgeon Lakes is intercalated with and overlies, on the basis of pillow top measurements, a succession of felsic to intermediate metavolcanics. This mafic to intermediate succession consists predominantly of fine- to medium-grained flows, minor coarse-grained flows or centres of flows, and local porphyritic, pillowed, and amygdaloidal flows. Amygdaloidal flows are more abundant towards the top of this succession as evidenced by their abundance along Sturgeon Narrows; the amygdules are generally filled with quartz ± carbonate. It is possible that some of the carbonate had its source in carbonate-rich fluids given off from the Sturgeon Narrows Alkalic Complex. Autoclastic breccia was observed along Sturgeon Narrows but whether its position is a reflection of increasing brecciation of the volcanic flows towards the top of the succession or is simply a reflection of good exposure is uncertain. Mafic pyroclastics, generally lapilli tuff, were locally observed, especially along the north shore of Sturgeon Lake where they are intercalated with metasediments.

STURGEON NARROWS–POST LAKE AREA

A second succession of mafic to intermediate metavolcanics is exposed north of Post Lake and southeast of Sturgeon Narrows. With reference to the possible age of this succession, Pettijohn (1937, p.179) proposed that the metasediments exposed along Post, Add[1], and Willet[1] Lakes separated two different series of metavolcanics:

> A few sediments...crop out at East Bay of Sturgeon Lake and extend southwestward, along Sturgeon Narrows, to a point beyond Seaton Island, a distance of about 12 miles [19 km]. Here, they are apparently connected to a second band, which bends sharply back and extends 12 or 13 miles [19 to 21 km] southeast and east. The sediments contain conglomerate, bearing granite pebbles and graywacke...if it be assumed that the sediments form a series that separates two series of volcanics, as

[1]Add and Willet Lakes are south of the Quest Lake map-area.

they do in the Savant area, then the two belts, which join at about a 45-degree angle, to make a great 'V', form the limbs of a great anticline with pitch to the west. This interpretation of the structure would make most of the volcanics of this area younger, or post-sedimentary, instead of Keewatin. The greenstones between the Sturgeon Narrows band and the band that extends east from Seaton Island—that is, those lavas within the 'V'—would be true Keewatin.

The metasediments to which Pettijohn refers are those extending down Sturgeon Narrows and those exposed on Post, Add, and Willet Lakes. The so-called Keewatin comprises the succession under discussion. Top determinations based on pillow orientation indicate, however, that the Sturgeon Narrows–Post Lake metavolcanics possibly overlie the metasediments exposed along Barge and Post Lakes. The relationship between these metavolcanics and the metasediments exposed along Sturgeon Narrows is uncertain.

This succession is unique for the presence within it of four moderate-sized bodies of serpentinized peridotite. Except for minor ultramafic rocks exposed on Mountain Island (*see* Trowell 1974a) these are the only occurrences of ultramafic rocks known at present in the Sturgeon Lake area. Their occurrence could be taken as evidence that the metavolcanic assemblage in this area is distinctly different, perhaps in age as suggested above, from the other metavolcanic assemblages in the map-area.

This second mafic to intermediate succession has units similar to the first, but a diversity of the structural trends suggests that structural complexity exists, perhaps in the form of cross-folds.

STURGEON LAKE, SOUTH SHORE AREA

Mafic to intermediate metavolcanics are exposed on the shore of, and south of Sturgeon Lake. They appear to stratigraphically separate two assemblages of felsic to intermediate metavolcanics. The southern assemblage of felsic to intermediate metavolcanics has been previously described (Trowell 1974b).

Felsic to Intermediate Metavolcanics

Three major assemblages of felsic to intermediate metavolcanics are exposed in the map-area. They are located: in the Six Mile Lake area; along the south shore of Sturgeon Lake; and between Post and Quest Lakes. The relative age relationships of these three assemblages are not known.

All the felsic to intermediate metavolcanics have been metamorphosed under greenschist facies conditions.

SIX MILE LAKE AREA

An assemblage of felsic to intermediate metavolcanics is present in the Six Mile Lake area; it extends to the northern boundary of the map-area. Top determinations (based on graded bedding within the pyroclastic-volcanic clastic

rocks of map-unit 2) indicate that it is facing south and thus it apparently is stratigraphically above the 'lower' mafic to intermediate metavolcanic sequence which lies to the north (*see* Map 2169, Davies *et al.* 1970). The felsic to intermediate assemblage is overlain by and intercalated with the mafic to intermediate metavolcanic sequence exposed between Six Mile and Sturgeon Lakes. This assemblage is extensively intruded by irregularly shaped bodies of metagabbro and metadiorite which the author considers to possibly represent the intrusive feeder equivalents of the mafic to intermediate metavolcanics which overlie it, though some may in fact be flows. The assemblage decreases in apparent thickness and becomes increasingly intercalated with mafic to intermediate metavolcanics to the east along Sturgeon Narrows, suggestive perhaps of a thinning on the flanks of an original volcanic edifice.

This assemblage appears to be primarily of pyroclastic-volcanic clastic origin and in part of autoclastic origin. Some of the apparently non-fragmental porphyritic units could be either flows, or fine-grained pyroclastics or intrusions (hypabyssal).

Three partial chemical analyses (Mineral Research Branch, Ontario Division of Mines) of the pyroclastics are in the dacite to rhyodacite compositional range. These rocks weather white to pink to green-yellow. In general, the rock clasts have approximately the same composition as the matrix and thus are at times difficult to distinguish.

The northern portion of this assemblage comprises pyroclastic and reworked pyroclastic rocks, and well stratified volcanic clastic[1] rocks which may be either of pyroclastic or epiclastic origin. All these rocks contain dominantly siliceous volcanic clasts. A central unit might be autoclastic in origin because the clasts, which are angular and closely packed, are similar in composition to the matrix. To the south, mixed units of crystal tuff, lithic-crystal tuff, lapilli tuff, lapillistone and minor tuff-breccia are found. These southern units are more noticeably quartz-porphyritic than those to the north. Locally well-bedded volcanic clastic units are found. Cherty tuffaceous? units are also found, predominantly in the southern portion of this assemblage.

In thin section, these units are seen to consist of the following assemblage: clasts generally of lapilli size + subrounded slightly corroded quartz phenocrysts + fine-grained quartz ± subhedral, slightly corroded, albitic plagioclase phenocrysts + fine-grained plagioclase grains ± myrmekite ± chlorite + sericite + carbonate ± epidote ± opaque oxides ± sulphides. The myrmekite may indicate an intrusive hypabyssal origin. The carbonate content is highly variable, but while individual units or narrow zones were markedly carbonatized, no extensive areas of carbonatization or any other significant alteration were noted. Fine-grained hematite, locally specularite, is disseminated in some of these rocks.

Graded bedding, suggestive of subaqueous deposition and/or reworking, was locally observed. In general though, the fragmental rocks occur in thick massive units.

The recognizable felsic dikes, except for their slightly distinctive porphyritic texture and apparently non-fragmental appearance, have approximately the same composition as the fragmental units and thus, where unit relationships were obscure, the two were difficult to distinguish.

[1]On Map 2335, volcanic clastic rocks are included with the pyroclastic rocks of unit 2a,b,c.

ODM 9416

Photo 1–Lapillistone to tuff-breccia exposed on north shore of Six Mile Lake. The subangular to subrounded fragments and the matrix are intermediate to felsic in composition.

Photo 1 shows a unit of lapilli tuff and lapillistone which is exposed on the north shore of Six Mile Lake. This unit is traceable for approximately 1.2 km (0.75 miles) to the northeast. It has been intruded and disrupted by mafic intrusives.

These rocks vary from weakly foliated to strongly schistose. Locally a secondary crenulation foliation has developed on the pre-existing foliation planes but this was apparent in only one thin section, and thus could be due to local kink banding.

Because of areas of poor exposure, the unknown effects of any folding that might have occurred, and the irregular distribution of the mafic intrusions, it was not possible to determine an accurate thickness of this assemblage. There do appear to be areas, however, such as east of Six Mile Lake where there is an appreciable apparent thickening of these units that may reflect original centres of accumulation.

STURGEON NARROWS AREA

A thin 'glassy' unit outcrops just west of the central portion of Sturgeon Narrows. Its interpreted extent is 45 m (150 feet) wide and 900 m (3,000 feet) long. It is composed of medium- to fine-grained, shard-like fragments set in a matrix of brownish, fine-grained, slightly opaque material possibly representing devitrified glass. The internal parts of the shards are composed of a cryptocrys-

talline fibrous aggregate, possiby pseudomorphic after tridymite. Amygdules locally impinge on the edge of the shards. Locally fine 'comb' quartz has grown within the interstices between the shards. The rock's pseudo-welded appearance is probably a result of compaction and possibly later deformation. This unit could be a hyaloclastite or aquagene tuff as described by Carlisle (1963). If this unit is a hyaloclastite, it quite probably is more mafic than it appears.

STURGEON LAKE, SOUTH SHORE AREA

Along the south shore of Sturgeon Lake, felsic fragmentals are intercalated with thin bands of mafic to intermediate lapilli tuff and metasediments. The presence of metasedimentary interbands and the occurrence of carbonaceous material, presumably graphite, in the felsic fragmentals indicate that this assemblage might be transitional to the metasedimentary assemblage that trends along the approximate centre of Sturgeon Lake. Some of these fragmentals, specifically on the small island just off-shore, appear to be of autoclastic or agglomeratic origin, suggestive perhaps of subaerial volcanism. The assemblage is characterized by rather coarse clasts in the lapillistone to pyroclastic breccia range. These rocks weather white to pink and their outcroppings have a blocky jointed appearance.

The rocks of this unit are schistose and may be warped or folded. The schistosity trends ENE to southeast, and dips moderately to steeply north. The schistosity approximately parallels bedding. Small-scale, parasitic folding and kink folding were observed.

The mineralogical composition of these rocks as seen in thin section is: quartz + plagioclase (albite-oligoclase) ± sericite ± biotite ± chlorite ± epidote. Accessories include minor carbonate, pyrite, and iron-titanium oxide. Disseminated graphite and graphite stringers up to 15 cm (6 inches) in length are present in places. The rock clasts are fine-grained, dark grey, cherty-looking and appear felsic in composition. Quartz veins locally cut these rocks.

This assemblage is apparently the youngest sequence of felsic to intermediate metavolcanics underlying and south of Sturgeon Lake (cf. Trowell 1974b). Stratigraphically it appears to be the fourth major sequence of felsic to intermediate metavolcanics in the present map-area and the area to the south (Trowell 1974b), each sequence being separated from the previous sequence by an asemblage of mafic to intermediate metavolcanics.

The stratigraphic sequence on the south shore of Sturgeon Lake is from felsic-to-intermediate metavolcanics of pyroclastic and volcanic clastic origin to metasediments, with possibly some intervening mafic flow and pyroclastic rocks. On the north shore, the stratigraphic sequence is from metasediments to intermediate metavolcanics although here also the contact zone is covered by Sturgeon Lake.

Erosion of the volcanic pile south (and north?) of Sturgeon Lake likely provided the source for the metasediments along the centre of Sturgeon Lake. The environment of deposition would appear to have changed from one in which graphitic sulphide horizons could have formed, e.g. the metavolcanics underlying and south of Sturgeon Lake, to one in which oxide facies iron formation could

have formed, e.g. the metasedimentary formation along the centre of Sturgeon Lake. Metasediments directly overlie a southern predominantly mafic to intermediate assemblage along the Barge-Post-Add chain of lakes perhaps reflecting deposition on the flanks of the original volcanic pile. It is not known whether the contact between the metavolcanics and metasediments is concordant or discordant because it is covered by Sturgeon Lake.

POST AND QUEST LAKES AREA

A third assemblage of felsic to intermediate metavolcanics is exposed between Post and Quest Lakes. This assemblage has an unusual outcrop configuration, although the boundaries might be changed by subsequent more detailed mapping. The configuration might be a reflection of original constructional features, that is, it represents an original concentration of felsic to intermediate metavolcanics in a domical centre of volcanism. Its configuration might also be a result of superimposed folds (cross-folding) or it could represent a combination of these two factors. The variation in the foliation trends possibly supports the cross-folding hypothesis. This assemblage is also unique in that it has been intruded (the contact is now sheared) by serpentinized peridotite.

Locally this assemblage contains intercalated, mafic to intermediate, amygdaloidal and pillowed flows.

Pyrite, locally accompanied by minor chalcopyrite, was observed disseminated in and filling the interstices between the fragments within this assemblage. In one outcrop an angular piece of polygranular pyrite itself appears to be a fragment approximately 2.5 cm by 2.5 cm (1 inch by 1 inch).

Metasediments

Metasediments of the Quest Lake area occur in four localities: they are (1) Sturgeon Lake, (2) Sturgeon Narrows, (3) Barge and Post Lakes, and (4) Quest and Princess Lakes. Each locality is characterized by a slightly different assemblage of metasediments reflecting perhaps differences in source, environment of deposition, metamorphism, and age.

STURGEON LAKE METASEDIMENTS

The metasediments, which are exposed on the central islands and north shore of Sturgeon Lake, consist predominantly of interbedded greywacke and polymictic conglomerate. The clasts of the conglomeratic units are primarily volcanic in derivation and are pebble- or less commonly cobble-sized. In estimated order of decreasing abundance the clasts are: felsic to intermediate (both fine-grained and porphyritic) and mafic volcanic rocks; fine-grained 'cherty' volcanic rocks; and minor granitoid (volcanic hypabyssal) rocks. The granitoid clasts are most likely derived from the hypabyssal equivalents of the felsic to intermediate

metavolcanics. The conglomeratic units have a greywacke matrix.

In thin section the greywacke units consist of: fine-grained, lithic (volcanic) clasts set in a matrix of angular to subangular quartz and plagioclase grains ± small felsic (chert?) chips, + chlorite variable in amount from 5 to 20 percent ± sericite ± carbonate ± epidote ± magnetite ± 1 to 2 percent disseminated sulphides and sulphide clasts (?) (pyrite and pyrrhotite). Variation in the chlorite content determines the colour of the greywacke.

The conglomeratic units are poorly sorted, mostly unstratified or only locally stratified, and not apparently graded. The greywacke interbeds define the local plane of bedding. The larger clasts are roughly elliptical in shape and have their long axes aligned in the plane of schistosity.

Metagabbro and metadiorite sills and dikes intrude and locally contain inclusions of these metasediments.

STURGEON NARROWS METASEDIMENTS

The metasediments exposed on the islands and west shore of Sturgeon Narrows consist of conglomerate, greywacke and minor siltstone. They tend to be lithologically distinct from the metasediments of Sturgeon Lake in that the greywackes contain only minor lithic clasts and less chlorite and sericite in the matrix, and the conglomerates have a different fragment population. The original lithology is locally obscured by the alteration (fenitization) effects of the Sturgeon Narrows Alkalic Complex. Generally these effects are limited to a development of a pink colouration in the metasediments. Locally, however, such as on the west shore of Sturgeon Narrows, across from Narrows Island, pebble conglomerate units have been extensively feldspathized to the extent that pebbles are no longer distinguishable from the matrix except in places on weathered surfaces due to differential weathering. It is feasible that even more intense fenitization may have transformed some metasedimentary units into rocks essentially indistinguishable from, and thus grouped with the rocks of the Sturgeon Narrows Alkalic Complex.

The conglomerate units exposed on Narrows Island contain mainly cherty clasts, whereas the units on the west shore contain mainly volcanic and rare jasperoid clasts set in a highly chloritic greywacke matrix. On the west shore intermediate pyroclastics and conglomerate appear to be intercalated.

In thin section the greywackes are seen to be characterized by the following assemblage: quartz + plagioclase ± perthite + chlorite ± sericite + carbonate + sulphides + iron oxides. Lithic clasts are locally present in minor amounts.

Subangular to subrounded quartz and feldspar grains are set in a fine-grained matrix of chlorite + sericite + carbonate. The matrix averages 10 to 15 percent and rarely makes up more than 20 percent of the rock. A thin section of greywacke from Narrows Island contains approximately 10 percent perthitic (orthoclase perthite) feldspar porphyroblasts which are believed to be the result of pervasive potassic fenitization accompanying intrusion of the Sturgeon Narrows Alkalic Complex. The moderately fenitized metasediments appear to be characterized by a pervasive sericitization and the presence of abundant finely disseminated iron oxide aggregates. The conglomerates on the west shore of Sturgeon

Narrows have a very 'mafic' greywacke matrix containing up to 50 percent chlorite.

Thin units of greywacke-siltstone are locally intercalated with the metavolcanics along the west shore of Sturgeon Narrows.

The conglomeratic units are unstratified to poorly stratified, and poorly sorted. A schistosity has developed approximately parallel to the original bedding.

BARGE LAKE–POST LAKE METASEDIMENTS

The metasedimentary assemblage of this area has been previously described by the author (Trowell 1974b, p.11):

> The metasediments are dominantly greywacke and siltstone, with minor conglomerate, arkose, and argillite. Intercalated with these metasediments are schistose tuffaceous bands.

Structural trends, similar lithological assemblages including the presence of oxide facies iron formation, and the general trend of the aeromagnetic pattern (ODM-GSC 1961) indicate that this metasedimentary assemblage is probably continuous with the Sturgeon Lake metasediments. Actual outcrop information is lacking however, and the gap in the aeromagnetic pattern south of the entrance to Sturgeon Narrows might indicate that the original sedimentary basin was divided into two separate lobes, with respect to the formation of the oxide-facies iron formation.

QUEST LAKE–PRINCESS LAKE METASEDIMENTS

The metasedimentary assemblage in the area of Quest and Princess Lakes consists of conglomerate, greywacke, argillaceous greywacke, siltstone, spotted schists, and metasedimentary schists and gneisses.

A mafic conglomerate unit is centred around Princess Lake. Gabbroid and mafic volcanic clasts, and minor felsic clasts are set in a lithic greywacke matrix. In thin section the matrix consists of approximately 80 percent fine mafic clasts, 10 percent subangular, medium-grained, quartz and zoned plagioclase grains and 10 percent interstitial, fine-grained, quartz, feldspar, and chlorite. This unit is not bedded, is poorly sorted to unsorted, and has a chaotic appearance. Locally the unit looks like a volcanic breccia; it probably was deposited close to its source area, possibly as a debris flow or lahar. It appears to be a discrete conglomeratic unit overlying the finer grained metasediments to the south and east, and possibly overlying the metavolcanics to the south.

Along and east of Quest Lake the metasediments consist of a bedded assemblage of greywacke, argillaceous greywacke, and minor conglomerate. Some of the argillaceous greywacke units (spotted schists) just east of Quest Lake have a spotted appearance caused by stud-like grains (or aggregates) along the bedding planes. These stud-like grains which average 3 by 1.5 mm were tentatively identified in the field by both Rogers (1964, p.24) and the author as staurolite and/or andalusite. X-ray analysis by the Mineral Research Branch, Ontario Division of

Mines, determined that they are an aggregate of quartz, feldspar, and white mica (possibly the retrograde equivalent of aluminum silicate minerals) indicating that these metasediments have been perhaps subjected to retrograde metamorphism.

Toward the Vista Lake Complex, the metasediments gradually are mineralogically and structurally reconstituted to schist and gneiss. Original bedding is accentuated by metamorphic recrystallization and the appearance of high grade minerals. The schistosity and gneissic structure planes appear to parallel original bedding. The metamorphic grade appears to increase toward the intrusion, from greenschist (biotite and biotite-garnet subfacies) to almandine amphibolite facies. Texturally the metasediments become increasingly more granoblastic-polygonal, and porphyroblastic growth of biotite and feldspar is evident. It is uncertain how the previously mentioned retrograde metamorphism can be correlated with this increase in metamorphism toward the Vista Lake Complex.

To the west of Princess Lake, the metasedimentary assemblage appears to be intercalated with metavolcanics, although as previously suggested the metavolcanics may overlie the metasediments. In this area both the metavolcanics and metasediments have been intruded by and locally fenitized by the Sturgeon Narrows Alkalic Complex.

Carbonate is locally abundant in these metasediments both as fine, disseminated grains and in cross-cutting veinlets.

The 'gabbroid' conglomerate described above is a rather unique unit and is distinctly different from the greywacke assemblage near Quest and Princess Lakes. It would appear to have been derived from a different source area as exemplified by the gabbroid clasts, and may in fact be a different age than the greywacke assemblage. It occurs at the top of the sedimentary succession of the Princess–Quest Lake area and appears confined to the area north and west of Princess Lake in proximity to intermediate and mafic metavolcanics.

Iron Formation

Thin discontinuous units of oxide (magnetite) facies iron formation were found in the Quest Lake–Princess Lake, and Barge Lake–Post Lake metasedimentary assemblages. Minor sulphides occur along with magnetite. As well, iron formation was aeromagnetically interpreted (ODM-GSC 1961) to be present along the centre of Sturgeon Lake. Sulphide-facies iron formation, locally accompanied by minor graphite, was observed by the author in the drill core from the Arctic Yellowknife Mines Limited property located on and north of Quest Lake. Several other horizons of graphite ± sulphide, and sulphide mineralization are reported to have been intersected in diamond-drill holes in the metasedimentary assemblages (*see* 'Description of Properties').

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

Metagabbro and Metadiorite

Rio Tinto Canadian Exploration Limited was kind enough to supply the author with detailed geological maps for the area surrounding and north of Six Mile Lake. Their mapping of the various rock units and the relationships of these units agreed quite closely with similar observations made by the author and, therefore, because of the more detailed nature of their mapping program, their interpretation of this area has been incorporated in the present report and maps.

In the metavolcanic sequence, and specifically in the mafic metavolcanics it is extremely difficult to distinguish metagabbro and metadiorite intrusions from the medium-grained to coarse-grained centres of flows. On the shore and north of Six Mile Lake, mafic intrusions cut both felsic metavolcanics and other mafic intrusions. Locally, chill zones helped to define the boundaries of single intrusions.

One apparent field aid to the identification of these intrusive bodies was the presence in them of substantial amounts (2 to 5 percent) of titanite which varies in colour from white to purple to orange.

Three chemical analyses and calculated normative compositions (following the methods of Irvine and Baragar 1971) are given in Table 2. Samples 1-1-7 and 3-1-11 were collected north of Six Mile Lake while sample 2-25-2A is a representative sample of an intrusive body located northeast of Post Lake.

Typically the metadiorite-metagabbro intrusions are fine grained to medium grained to locally coarse grained. They possess an equigranular to subophitic to locally porphyritic texture. On weathered surfaces they are grey to grey-green while on fresh surfaces they are green to grey-green.

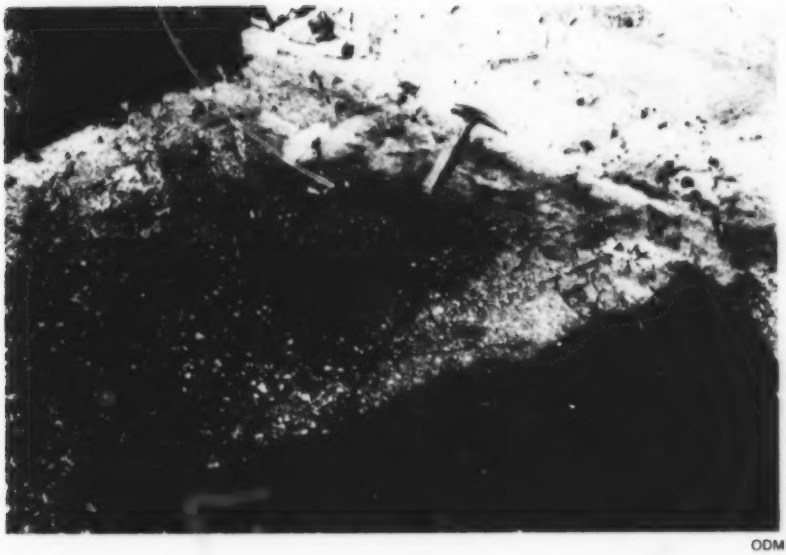
The typical mineralogical assemblages present are: plagioclase + amphibole ± quartz ± myrmekite ± chlorite + epidote ± carbonate + titanite ± opaque oxides ± sulphides.

The subhedral plagioclase laths are invariably almost completely altered to saussurite thus precluding efforts to determine their composition, though the presence of carbonate ± epidote pseudomorphs and the normative plagioclase composition (*see* Table 2) do suggest an originally calcic composition. Amphibole is generally pale green to almost colourless (tremolite-actinolite series) and occurs both as euhedral phenocrysts and as fibrous laths. Quartz occurs as anhedral interstitial grains with an interlocking habit indicating that it was a late crystallizing phase; it is generally present in amount equal to or less than 10 percent of the rock. Replacement myrmekite locally developed as fringes on the plagioclase laths. Carbonate and epidote occur both as interstitial, subhedral to anhedral grains and together as saussurite pseudomorphs after the plagioclase. Chlorite occurs as an alteration of the amphibole and in cross-cutting veinlets. The assemblage of epidote + carbonate + chlorite is considered by the author to indicate that these intrusions were metamorphosed under greenschist facies conditions. Titanite is ubiquitous in amounts ranging from 2 to 5 percent. Locally, where these rocks have been sheared or faulted, fibrous tremolite (tremolitic

TABLE 2 CHEMICAL ANALYSES AND NORMATIVE COMPOSITIONS OF MAFIC INTRUSIVE ROCKS.

Chemical Analyses in Weight Percent[1]			
Sample Number	1-1-7	3-1-11	2-25-2A
SiO_2	51.0	51.4	52.2
Al_2O_3	12.5	12.7	12.9
Fe_2O_3	3.15	2.20	1.32
FeO	9.12	10.8	6.82
MgO	7.12	6.33	9.85
CaO	10.3	10.7	12.7
Na_2O	2.02	1.52	1.31
K_2O	0.06	0.26	0.17
H_2O^+	2.74	2.45	1.93
H_2O^-	0.12	0.05	0.03
CO_2	0.51	0.22	0.19
TiO_2	1.17	1.06	0.35
P_2O_5	0.03	0.02	0.01
S	0.01	0.08	0.01
MnO	0.20	0.25	0.17
Total	100.0	100.0	100.0
Specific Gravity	2.98	3.03	3.04
Normative Compositions in Mole Percent[2]			
Quartz	5.635	7.131	4.123
Albite	19.113	14.387	12.027
Anorthite	29.211	28.538	29.476
Plag. Composition	An57	An66	An71
Orthoclase	0.374	1.621	1.028
Diopside	13.799	12.135	20.744
Ferrosilite	8.168	9.881	6.032
Hedenbergite	8.158	9.704	7.177
Enstatite	13.718	1.557	1.499
Magnetite	2.942	2.425	1.411
Pyrite	0.000	0.220	0.027
Apatite	0.066	0.044	0.021

1 *Analyses by Mineral Research Branch, Ontario Division of Mines.*
2 *Following the method of Irvine and Baragar (1971).*
Note: Sample locations given in text.



ODM 9417

Photo 2–Porphyritic (leopard-rock) metadiorite dike located along the north shore of Six Mile Lake. Dikes of this type are intrusive into both other mafic intrusive rocks and the felsic to intermediate metavolcanic assemblage exposed on the shore and north of Six Mile Lake. Phenocrysts are of albitic plagioclase composition. The dark portion of the photo is in shadow.

asbestos?) often accompanied by quartz, developed along the shear or fault planes. Owing to general absence of magnetite in these intrusions, there is little or no magnetic contrast between them and the felsic metavolcanics which they intruded.

These intrusions are generally structurally massive but locally a weak foliation, paralleling the regional trend, has developed by the parallel alignment of the mafic minerals. They show a moderately well-developed joint pattern which locally tends to distinguish them from the mafic metavolcanics. Porphyritic metadiorite (leopard rock) dikes (Photo 2) containing subrounded, zoned plagioclase phenocrysts cut both the metavolcanics and the more massive mafic intrusions.

It is speculated, by the author, that the mafic intrusions located north of Six Mile Lake represent the feeders for the mafic metavolcanic succession which lies between Six Mile and Sturgeon Lakes. This interpretation is reinforced by a small number of top determinations in the area north of Sturgeon Lake suggesting that the stratigraphic succession is younger from north to south.

Two small bodies of metagabbro, which are of slightly different character both mineralogically and texturally from those described above, intrude the mafic metavolcanic succession south of Six Mile Lake. The first is located 2.0 km (1.25 miles) east of the west end of Six Mile Lake and 0.24 km (0.15 miles) south of the lake. It has an ophitic to subophitic texture, and its mineral assemblage is:

plagioclase partially altered to saussurite + medium-green amphibole (hornblende series) partially altered to fibrous brown biotite ± myrmekite which occupies interstices + titaniferous magnetite ± pyrite + pyrrhotite + apatite (3 to 4 percent).

The second body is located 4.0 km (2.5 miles) east of the west end of Six Mile Lake and lies approximately 0.8 km (0.5 miles) south of the lake. It is medium-grained, and has a subophitic texture with local porphyritic to glomeroporphyritic phases. Its mineral assemblage consists of plagioclase + amphibole (tremolite-actinolite series) + chlorite + titaniferous magnetite + minor apatite.

These two bodies are different from those previously discussed in that they contain significant amounts of titaniferous magnetite, are more phosphorous rich as evidenced by the presence of apatite, contain no quartz, and the first one described is characterized by the presence of both hornblende and biotite. It is suggested that these two bodies which intrude the mafic metavolcanic succession might be younger than those which are located on the shore and north of Six Mile Lake, although their stratigraphic position does not preclude an association with the mafic to intermediate volcanism.

Several other similar mafic intrusions were mapped in other parts of the area where they have intruded the felsic and mafic metavolcanics. Mafic intrusions intrude the metasedimentary sequence near and east and west of Princess and Quest Lakes.

Determining the relative age relationships of the metavolcanic and metasedimentary sequences is a problem in this area. The mafic intrusions are of course later than the metasediments they intrude but whether the volcanism and sedimentation were taking place together or whether the metavolcanics and their associated intrusions west of Quest Lake represent a pre- or post-sedimentary sequence has not yet been determined. The presence of gabbroid clasts, which are believed to have been derived from the volcanic-associated mafic intrusive bodies, in the conglomerate unit exposed on Princess Lake indicates that sedimentation, at least in part, post-dated volcanism. This problem is discussed in greater detail above under 'Metasediments'.

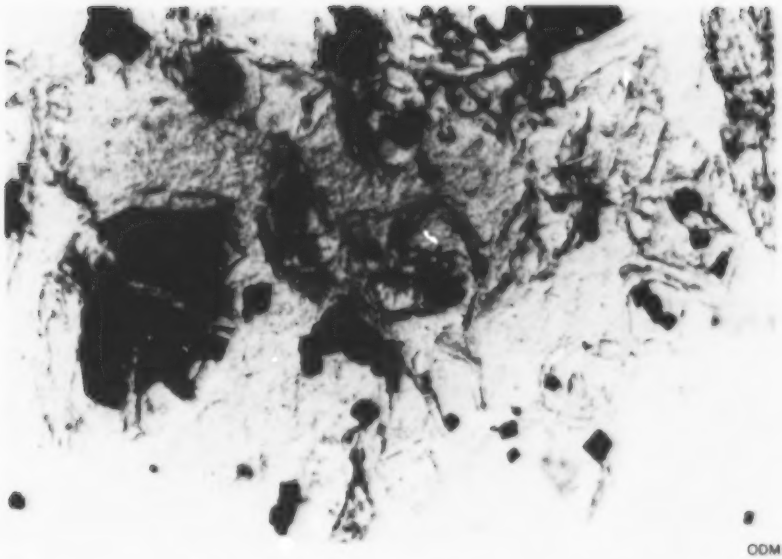
Metamorphosed Ultramafic Rocks

Four bodies of serpentinized peridotite apparently intrude the metavolcanic succession north of Barge and Post Lakes, forming a chain approximately 6 km (4 miles) long. They vary from approximately 0.8 to 2.4 km (½ to 1½ mile) in length and approximately 200 to 500 m (650 to 1,650 feet) in width. Their long dimensions trend ESE, both parallel to and slightly discordant to the foliation of the nearby metavolcanics. Their boundaries were interpreted from observed field relationships, from an ODM-GSC aeromagnetic map (1961) and from aeromagnetic maps submitted for assessment credit (*see* 'Alex Mosher' in Table 5).

At present with the exception of a small body of serpentinized peridotite located on Mountain Island (Trowell 1974a, Map 2268), these are the only ultramafic bodies known within the Sturgeon Lake area.

The ultramafic rocks are marked by very high magnetic responses caused by the abundance of magnetite in them as verified by petrographic examination.

These rocks weather dark green, locally with a purplish tinge, whereas on fresh surfaces they are very dark green. In thin section these rocks are seen to



ODM 9418

Photo 3–Photomicrograph of serpentinized peridotite from ultramafic body located north of Post Lake. Olivine grains have been completely altered and pseudomorphed by serpentine. Locally they are extensively pseudomorphed by magnetite (dark black grains). Magnetite grains also occur in the serpentine + chlorite groundmass. Plane light, X.20.

consist of 60 to 80 percent olivine now completely altered to pale green serpentine (lizardite?) 10 to 15 percent pale green tremolitic amphibole, 5 to 10 percent magnetite, 0 to 5 percent carbonate, 1 to 2 percent sulphides, 0 to 5 percent clinopyroxene partially altered to serpentine, and 0 to 5 percent chlorite. The texture is variable from equigranular to poikilitic wherein remnant pyroxene and amphibole after pyroxene enclose several olivine-serpentine grains. The relict olivine grains are generally anhedral to subhedral and show only a slight variation in grain colour. Carbonate occasionally occurs as a replacement of olivine. Magnetite is variable in habit – it occurs as fine-grained aggregates along the curving fractures in and partially rimming olivine, commonly as almost complete pseudomorphs of olivine, and as interstitial grains apparently completely exsolved from the original olivine grains (Photo 3). The fact that an original olivine grain is almost completely pseudomorphosed by magnetite suggests that magnetite might be mobile during the serpentinization process because even an iron-rich olivine would probably be unable to release enough iron during serpentinization to form magnetite to the extent observed. It is not uncommon, in thin section, to see a completely serpentinized olivine and clinopyroxene. Talc veinlets and fracture fillings were locally seen in outcrop. One to two percent sulphides, primarily pyrrhotite, occur as interstitial grains. A brown amorphous substance was observed on the weathered surface of the serpentinized peridotite. It was identified as deweylite ($4Mg0.3Si0_2.6H_20$) by X-ray analysis performed by the Mineral Research Branch, Ontario Division of Mines. Deweylite is believed

to have a composition similar to serpentine but contains more water. The Mineral Research Branch, Ontario Division of Mines, assayed several grab samples of ultramafic rock collected by the field party for Cu, Ni, Co, Pb,and Zn but only trace amounts of these elements were detected.

The linear alignment of these bodies suggest that their emplacement was in part controlled by structure. It is not known whether some of the metagabbroic units in the immediate vicinity of these bodies are genetically related to the ultramafic bodies.

The one contact seen by the field party was a sheared contact between serpentinized peridotite and felsic to intermediate pyroclastics.

FELSIC INTRUSIVE ROCKS

Porphyritic Intrusive Rocks

Quartz porphyritic, quartz-feldspar porphyritic and feldspar porphyritic sills, dikes, and irregular masses intrude both the metavolcanic and metasedimentary sequences in the Quest Lake map-area. Although many of these intrusions, in hand specimen at least, appear to be compositionally similar hypabyssal equivalents to the felsic to intermediate metavolcanics which they intrude, the origin of others which cut the mafic and intermediate metavolcanics and metasediments is not known. In thin section they are seen to consist of albitic plagioclase and qūartz phenocrysts set in a fine- to medium-grained matrix of quartz + plagioclase + sericite ± chlorite. They do not appear to be chemically or spatially related to the Sturgeon Narrows Alkalic Complex.

Saunders Lake Pluton

A felsic intrusion having an approximate composition of granite to granodiorite is exposed on the shore and west of Saunders Lake in the northwest corner of the map-area. It is not known how large this body is or its exact relationship to the surrounding rock units. In hand specimen these rocks weather pink to grey, whereas on the fresh surface they are pink to white. They vary from medium grained to coarse grained and are equigranular. Mafic content, predominantly biotite, averages approximately 15 percent.

Vista Lake Complex

The Vista Lake Complex underlies the eastern portion of the map-area, and extends beyond the boundaries of the map-area. Rogers (1964, p.31) has previously described much of this complex including the portion covered by this report. The pertinent parts of his description are here quoted:

The Vista Lake quartz syenite is the largest syenitic body in the [Metionga Lake] map-area. It is a crescent-shaped intrusion about 3½ miles [5.6 km] wide at the centre, thinning gradually to the northeast and southeast. It intrudes hybrid granite gneiss and migmatite on the east and sedimentary rocks including iron formation, to the west and south. Large included bands of metasediments and dikes or sills of syenite in the sedimentary rocks are common along the border areas. Locally it is in *lit par lit* or arteritic association with the sedimentary rocks.

The syenite is locally cut by minor small granite pegmatite and fine-grained pink granite dikes. In hand specimen it is seen to be a pink porphyritic, biotite-hornblende-quartz leucosyenite. It is commonly gneissic, and the phenocrysts are of pink microcline feldspar up to ½ inch [1 cm] in length. In thin section the syenite contains: microcline and some microperthite, 55–65 percent; plagioclase (strongly altered), 15–25 percent; quartz, from less than 5 to 15 percent; chloritized hornblende and biotite, 1–10 percent; accessory sphene, apatite, leucoxene, magnetite, and pyrite, from a trace to 5 percent; and minor secondary epidote and carbonate.

The Vista Lake quartz syenite borders on a body of medium-grained, pink quartz monzonite, which underlies most of Goodman, King, and Empress lakes. This quartz monzonite locally contains scattered microcline phenocrysts and looks much like the Vista Lake syenite. A gradation between the two bodies of rock is indicated. It is quite probable that the quartz monzonite is the source of the granite pegmatite and fine-grained granite dikes that cut the Vista Lake syenite.

The author has previously described the southern portion of this intrusion (Trowell 1974b).

The rocks of the Vista Lake Complex within the map-area are quite variable in composition and several phases are present. In thin section the rocks are seen to consist of varying proportions of the following minerals: microcline and microcline perthite + plagioclase (oligoclase) generally showing minor saussuritization ± antiperthite + amphibole ± biotite + quartz in amounts ranging from 0 to 15 percent. Accessories include epidote, sphene, apatite, magnetite and calcite.

South of Jagged Lake, this intrusion consists predominantly of pink porphyritic biotite-hornblende syenite (Trowell 1974b). White but locally pink microcline and microcline perthite phenocrysts vary from 3 to 25 mm in length. Locally they have an elliptical shape. Plagioclase, generally stongly saussuritized, occurs as fine grains in the matrix and locally as phenocrysts. Biotite and hornblende are present in variable amounts; mafic content varies from 15 to 30 percent. Hornblende is generally dominant over biotite, and both are commonly altered to chlorite. The variable quartz content, evident in the porphyritic phases as well as the intrusion as a whole, is difficult to explain although assimilation of metasediments might be one possible explanation.

Along the north shore of Vista Lake, the complex has engulfed a band of metasediments producing a large scale *lit-par-lit* structure.

The magnetic attraction north of Vista Lake and west of Empress Lake is interpreted as a band of sedimentary iron formation which has been incorporated into the Vista Lake Complex.

Local hybrid and inclusion phases suggest that the intrusion assimilated significant amounts of metasediments and perhaps metavolcanics.

The body of monzonite, quartz monzonite, and associated dikes which underlies the area of Goodman and King Lakes is poorly exposed and its size and shape as shown should be regarded as only tentative. This quartz monzonitic phase might be a discrete intrusive body because it appears to intrude phases of the Vista Lake Complex.

These rocks possess a foliated to locally banded structure. The foliation is defined by the subparallel alignment of the mafic minerals whereas the banded

structure is defined by compositional banding in the intrusive bodies themselves (primary flow banding, gneissic structure?) and by the subparallel alignment of included bands of metasediments and of mafic inclusions.

The metasedimentary assemblage bounding the western borders of the Vista Lake Complex has been intruded and metamorphosed by the complex. East of Quest and Princess Lakes the metamorphic grade increases from greenschist to almandine amphibolite facies.

STURGEON NARROWS ALKALIC COMPLEX

An alkalic plutonic complex, the Sturgeon Narrows Alkalic Complex outcrops with moderate to marked positive relief along and east of Sturgeon Narrows. Actual outcrop exposure is, however, generally poor. The complex has a tadpole shape, being elongated in a northeasterly direction and tapering rather abruptly at its southwest end. It is 13.7 km (8.5 miles) long and varies in width from 1.3 km (0.8 miles) to 4.5 km (2.8 miles) (Davies *et al.* 1970). The northern extension of this complex was not examined during the present survey.

Beginning in the early part of this century several authors have described this complex.

Miller (1903, p.83-86,104,105) in his brief description of the Sturgeon Lake area mentioned that several boulders of nepheline syenite were found near the upper part of Sturgeon Lake. While the description of these boulders bears some resemblance to the rock units of the Sturgeon Narrows Alkalic Complex it should be kept in mind that these boulders were found north of the complex and thus they likely represent detritus from a different body of nepheline syenite. The description of these boulders is included here because the author believes that recognition of significant intrusive activity of alkalic affinity in the general Sturgeon Lake (Savant Lake) area will have important ramifications in interpreting the petrogenetic and structural history of this area.

The description of these boulders is as follows (Miller 1903, p.105).

> Hand specimens of the Sturgeon lake boulders show the rock to be light gray in color, and medium to coarse-grained in structure. The minerals that can be made out with the naked eye are feldspar, nepheline, black mica, magnetite, apatite and pyrite.
>
> Feldspar is the most abundant mineral in the rock and appears to be, so far as can be determined without the use of the microscope, all of the alkali variety. Carlsbad twinning is shown by some of the individuals which exhibit a tendency to take on a crystal outline, being set in a ground mass of nepheline.
>
> Nepheline is the most abundant constituent after the feldspar. On a weathered surface, which is, however, not characteristic of all the specimens, the nepheline has become stained a light brown, while the feldspar is to all appearance unaltered. The latter mineral here makes up approximately two-thirds of the mass of the rock, and the former one-third.
>
> Black mica is, after nepheline, present in the greatest proportion. In one specimen there is considerable apatite. This mineral shows a tendency to associate itself with the mica.
>
> The magnetite is present in subordinate amounts. One octahedral crystal, which has a diameter about two-thirds that of a pea, reminds one of the occurrence of this mineral in the nepheline syenite of Hastings county.
>
> One or two cubes of pyrite are present in the specimens. They have diameters of about the same length as that of the magnetite crystal just mentioned.

As is well known, nepheline rocks show a great tendency to exhibit variety of grain and mineralogical composition in comparatively small parts of the same mass, or even in a single hand specimen. It is therefore difficult to give a clear idea of the characteristics of a mass of this rock by describing a few thin sections.

Two small sections of the hand specimens described were examined microscopically by Prof. R.W. Brock, who has kindly furnished me with the following account of them:

"The rock is a hypidiomorphic granular one, consisting essentially of microperthite, microcline and hydronephelite, nepheline, with some biotite, amphibole and a little diopside (?). A little magnetite and some calcite secondary after the pyroxene are also present.

"The feldspars which make up the bulk of the rock are hypidiomorphic—some of them show crystal outlines. They have the well-marked cleavage and other characteristics of the alkali feldspars. No lime-soda feldspar was seen.

"Hydronephelite; A clear white mineral in leafy or columnar aggregates filling the interstices between the feldspar crystals. Index of refraction is low, double refraction high. It possesses rude cleavage parallel to the long axis of the columns, and this is the direction of the axis of least elasticity. Uniaxial. Positive. Gelatinizes with acids. It is no doubt an alteration product from nepheline which originally filled the interstices between the feldspars.

"The biotite is the most abundant colored constituent, but is present in only small amount in the sections. It occurs in two forms, in stout thick plates, having a deep brown color scattered through the sections, and in small green scales, giving generally a lath-shaped section showing perfect cleavage. These occur in groups, and do not appear to be altered forms of the brown biotite.

"Amphibole; Several large crystals of a deeply colored bluish green amphibole, somewhat resembling arfvedsonite, occur in the section. They do not show crystal terminations. The pleochroism is strong: ...deep bluish green,...olive green,...deep yellowish green....

"The double refraction is low. The extinction is high..."

E.S. Moore (1911, p.155) discussed the Sturgeon Narrows Alkalic Complex under the heading "Hornblende Syenites".

Lying along the eastern shore of the upper portion of the narrows on the lake, there is a large mass of rock which in appearance much resembles a light colored gabbro and has been mapped as gabbro on the Canadian Geological Survey's map. It appears much darker in some parts than in others, but in all the specimens examined the feldspars appear to be of the potash species, and one section showed a very little quartz, so that the rock is a syenite. It has much the appearance of some nephelite syenites though microscopic observations failed to show the presence of any nephelite.

The megascopic characters of the rock are a gray color, phanerocrystalline texture, crystals of pyrite, hornblende and good cleavage facies of feldspar resembling plagioclase, but lacking any sign of striations due to twinning.

Under the microscope one section is composed of the following minerals: Orthoclase, microcline, green hornblende, a little biotite and a small quantity of mica the pleochroism of which would identify it as zinnwaldite. The relation of this mica to the other minerals suggests that it has been introduced into the rock from an external source. Titanite in prismatic form and in acute rhombic sections is fairly common, and small crystals of it are frequently enclosed in the crystals of hornblende. A considerable amount of topaz is present and it shows as a colorless, slightly higher bi-refringent mineral than quartz, filling spaces between the feldspars and in places appears to have replaced portions of these minerals. Fluorite varying in color from blue, violet to colorless is quite common. It occurs in some cases as irregular streaks, but also as little cubes. It is found as small crystals in orthoclase, fills holes in topaz, and occupies cracks in the other minerals or the interstices between various crystals. Apatite is found in small crystals, and pyrite and magnetite in small quantity. Other thin sections show orthoclase, microcline, green hornblende, a little albite, small crystals of augite, apatite, a little tourmaline, considerable titanite, calcite, fluorite, topaz and a small proportion of quartz.

As mentioned in a previous section a pit in the syenite reveals a calcite vein with which are associated apatite, tourmaline, hornblende, zircon, pyrite and chalcopyrite.

In the presence of so many fluorite, boron, and titanium minerals we have good evidence of rather extensive fumarole action. On the cooling of the magma, fracturing on a small scale must have occurred and permitted the boron and fluorine gases to rise through the rock and replace some of the other minerals by new minerals. The quartz and calcite veins would be due to solutions filling some of these cracks.

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T.L. Gledhill (1924, p.33-37) gave a detailed description of the petrography and possible genesis of this complex.

The nephelite syenite was found in place on the east shore of the Narrows opposite the centre island of the three that lie in the Narrows. This centre island is composed of nephelite syenite that has been differentially weathered so as to expose a surface with book-like feldspars with the interstitial nephelite weathered out from between the feldspars....

The augite syenite on the Narrows is an elliptical-shaped mass that trends northeast paralleling the strike of the Keewatin greenstones. This rock is a topographic unit in itself and forms the highest ridge on this part of the lake.

The syenite approaches within a mile or so of the Sturgeon Lake granodiorite to the northwest and is more uniformily massive and coarser grained than the granodiorite. It has very little contact effect on the Keewatin greenstones and lacks the contact band of porphyrite that is usually found about the border of the granodiorite.

Three main types of syenite were observed; these could be separated on colour differences, the colours being grey, pink, and white. The grey gabbroid-grained syenite makes up the main mass, and the pink phase is commonest at the contacts on the greenstone, as on the east shore of Coveny island [north of the Quest Lake map-area]. The light-coloured phase occurs near the nephelite syenite, which is itself of this colour.

Sudden variations in texture is one of the outstanding macroscopic characters of the nephelite syenite, and wherever found, the rock had a bleached and puddled appearance. Veins of calcite, ten inches [25 cm] wide and frozen to the nephelite syenite, were found here. Besides calcite, they contain abundant equidimensional crystals of diopside. Titanite also occurs on the walls of these veins in crystals a quarter of an inch across, but they contain no graphite or any mineral indicative of a sedimentary origin for the calcite. Fluorite is common in the syenite bordering these veins. From the field relations, the veins apparently originated in tension fissures during the later stages of cooling of the syenite.

The grey syenite consists essentially of microperthite, anorthoclase, and microcline. The femic minerals are biotite and poorly transparent green pleochroic augite of small extinction angle. The accessory minerals are calcite, titanite, fluorite, apatite, scapolite, and pyrite.

The pink phase differs from the common grey type by having larger amounts of microcline.

The nephelite syenite is a light-coloured, medium to coarse grained rock with small dark green pyroxenes very sparsely scattered through it. The feldspars are euhedral for the most part and have an interstitial filling of nephelite and accessory minerals which are calcite, fluorite, sodalite, titanite, apatite, and zircon; they are predominantly microperthite with smaller amounts of anorthoclase and microcline. The feldspars appear to be replaced by nephelite...; this was deduced from the result of etching and staining a polished surface....

A mineral, yielding tests for a scapolite with a carbonate radical, appears in all the thin sections of the syenite examined, whether the rock was the normal type or the nephelite type. This mineral was observed replacing the feldspars. Few of the nephelite crystals were of the limpid type, but contained hair-like, regularly oriented inclusions, probably augite. The nephelite had the veined structure seen in microperthite and did not extinguish in all parts of the crystal at the same time when rotated under crossed nicols....

The nephelite syenite is a hypidiomorphic granular rock consisting essentially of microperthite, microcline, nephelite, anorthoclase, and soda pyroxene, with some biotite, fluorite, calcite, scapolite, and titanite. There is a small amount of magnetite, and pyrite.

The feldspars are chiefly microperthite and anorthoclase, with some microcline appearing in minor amounts.

The nephelite is a clear white mineral, forming an interstitial filling between the feldspar crystals and replacing them to a small measure. Its index of single refraction and double refraction is low. It possesses a rude cleavage parallel to the longer axis of the columns. The crystals are uniaxial and negative, and gelatinize with acids.

The biotite occurs in broad and narrow flakes, usually near or mixed with the pyroxenes. This biotite is markedly pleochroic.

Pyroxene is the commonest femic mineral present and occurs indiscriminately among the feldspars and nephelite, or occurs in fine needle-like forms with crystal outlines in the nephelite. The pyroxene sometimes has inclusion of biotite. This pyroxene is strongly pleochroic and poorly transpar-

ent. The pleochroic colours vary from a deep straw yellow to a deep bluish green....This pyroxene gave a strong flame test for soda and apparently is the acmite variety.

With regards to the genesis of the nepheline syenite Gledhill further commented (1924, p.37,38):

The nephelite-bearing syenite occurs in parts of the syenite mass which shows evidence of a greater amount of pneumatolytic action. This evidence consists of the bleached colour of the nephelite syenite, the presence of fluorite, titanite, and scapolite. The nephelite syenite is best explained by the residual soda-enriched portions of the syenite magma attacking the already crystallized feldspar and replacing it in part with nephelite and scapolite....

The nephelite is interstitial and is one of the last minerals to form. The earlier minerals, such as feldspar, are metastable to the soda-rich solutions which are built up towards the end of the crystallization of the magma. These later solutions effect some corrosion of earlier crystals, no doubt due to the effect of mass action, and then they pass upward as thermal mineral springs when the magma is finally consolidated.

A.R. Graham (1930, p.44) briefly discussed this complex.

The syenite along the narrows varies greatly in colour, texture, and composition. The main mass is a coarse, grey augite syenite, but pink phases are common along the border. Light-coloured nephelite syenite is also found in small amounts. Under the microscope the nephelite syenite is seen to consist of microperthite, microcline, orthoclase, augite, nephelite, some biotite, cancrinite, and titanite.

Rogers (1964, p.27-30) described the syenitic rocks that occur on the islands and along the shore of Sturgeon Narrows.

An elliptical body of scapolite-augite syenite is exposed with good relief on the south shore and islands of Sturgeon Narrows in Sturgeon Lake. Its long axis trends northeast. The body is about 9 miles [14 km] long, ranging in width from ¾ mile [1.2 km] on the southwest to about 2½ miles [4 km] on the north.

The syenite intrudes the surrounding volcanic and sedimentary rocks as indicated by decrease in grain size and porphyritization of the intrusion, and a notable alteration of the contact rocks. Foliation or zonal structure was not apparent from the author's [Rogers] brief examination; however, various phases were recognized.

The main mass is a very coarse-grained to porphyritic, grey, leucocratic rock. The feldspar phenocrysts weather high and often exhibit a trachytic texture....The interstitial material, scapolite, carbonate, and mafic minerals, generally weather low. In thin section the feldspar is seen to be microcline, plagioclase, and microperthite, commonly altered. Altered hornblende, pyroxene, and biotite are the ferromagnesian minerals. Accessory scapolite, apatite, magnetite, sphene, and carbonate make up the remainder of the rock. Gledhill (1925) reported the presence of accessory fluorite and pyrite.

The rock along the borders of the syenite intrusive mass is a pink, highly altered, microcline feldspar porphyry. The best exposures of this rock type are along the northwest shore of Seaton Island. A thin section showed outlines of highly altered feldspar, abundant carbonate, and unidentified fine-grained alteration material, with accessory pyrite and iron oxide. It is difficult to separate the pink porphyritic border syenite from the altered and 'porphyritized' metasediment on Seaton Island.

The large island [Narrows Island] northeast of Seaton Island, which shows the contact between the syenite and the metasediments, is a good example of the 'porphyritization' and alteration along the contact. The red or pink colour is not as prominent here. Thin sections of the porphyry from this location showed: highly altered plagioclase phenocrysts; some potash feldspar; a micaceous alteration matrix; minor biotite (chloritic) and highly altered, unidentified, ferromagnesian mineral(s); varied amounts of carbonate; and accessory magnetite, apatite, leucoxene, and iron oxide. A thin section of the relatively unaltered metasediment contained mostly clastic grains of quartz, feldspar, and lesser amounts of carbonate, chlorite, and leucoxene.

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It is in these areas of highly altered pink porphyritic syenite that the higher radioactive zones, discussed in the section on radioactivity...occur. These zones are found along the northwest shore of Seaton Island, in the previously mentioned island to the northeast, and on the south tip of Coveney Island just north of the [Quest Lake map-area]. Careful search along the line of contact will undoubtedly uncover more of these zones.

Specimens from the contact zone on the south shore of Sturgeon Narrows, southeast of Seaton Island, were examined in thin section. The medium-grained grey syenite at the contact is composed of highly altered phenocrysts of both plagioclase and microperthite, brown biotite containing numerous inclusions, chloritic alteration, and apatite (1 percent). A section of a radioactive breccia band showed highly atered plagioclase laths, potash feldspar(?), and abundant carbonate as rounded aggregates and stringers, in an altered, fine-grained micaceous aggregate, including chlorite, pyrite, and iron oxide. The basic volcanic rocks close to this contact are strongly sheared and carbonatized. Pyrite mineralization is abundant.

A brecciated zone, exposed over about 50 feet [15 m], comprising rounded and subrounded fragments of the syenite in a granulated matrix, located on the south shore of Sturgeon Narrows...registered about twice background radioactivity. A narrow, 2-foot-wide [0.6 m], radioactive gneiss phase of the syenite is located on the shoreline about 4 chains [80 m] northeast of the breccia. Tiny, short, black stringers are present in the gneissic phase. A basic dike (lamprophyre?) cuts the syenite adjacent to the gneiss phase. Continuing northeast along the shoreline for about 25 chains [500 m], numerous narrow shear zones and mylonitized coarse-grained syenite were observed. These are commonly radioactive, slightly pyritic, and show varying degrees of red alteration or rusty weathering. Occasional narrow carbonate veins were noted in this vicinity.

A light-coloured phase, of medium-grained to porphyritic to pegmatitic texture, is exposed in the west-central part of the syenite mass, and on the small island in the northern part of the Sturgeon Narrows. The outcrop on this island is of medium-grained, white to light grey, differentially weathered, scapolite-augite syenite. The small pyroxenes are sparsely scattered through it. A thin section of this rock shows altered phenocrysts of microcline and microperthite, to about 60 percent; phenocrysts, aggregates, and interstitial scapolite, to about 30 percent; with traces of strongly pleochroic green pyroxene. Gledhill (1925) reported veins of calcite, 10 inches [25 cm] wide, frozen to the nepheline syenite, containing diopside, and titanite crystals. The author [Rogers] did not see these veins in this area.

A thin section of a coarse-grained pegmatitic phase of the scapolite syenite from the south shore of the Narrows, south of the island mentioned above, showed: feldspar phenocrysts of plagioclase and microcline perthite, about 90 percent; small granular aggregates of scapolite, about 5 percent; pyroxene, granular carbonate, apatite, and biotite, less than 5 percent. A medium-grained specimen from about ½ mile [0.8 km] west of the pegmatite showed large phenocrysts of microcline and microperthite, lesser interstitial plagioclase, equigranular interstitial scapolite, brown-green biotite, and altered pyroxene (about 5 percent).

A specimen of medium-grained syenite from the northeast shore of the Narrows contains: tabular crystals of strongly altered microcline and microperthite, about 60 percent; interstitial scapolite, about 30 percent; altered pleochroic green pyroxene, less than 5 percent; carbonate, magnetite, pyrite, and apatite, less than 5 percent.

It is in this west-central area of the intrusion that Gledhill (1925, pp.35,36) reports the presence of nepheline....

In the few thin sections from this area studied by the author, no nepheline was recognized. Staining tests were carried out...on the sawed hand specimens, from which the thin sections were cut, to detect the presence of nepheline. The stain worked on some of the samples, but in each case it formed on scapolite grains. Apparently the method is applicable to scapolite as well as nepheline. D.F. Hewitt of the Ontario Department of Mines kindly examined the author's [Rogers] thin sections and hand specimens but was unable to detect the presence of nepheline in these specimens. It is entirely possible that the author [Rogers] did not sample the specific nepheline-bearing syenite. A more detailed examination of this area would be required to delineate the nepheline-bearing phases, if any exist.

The above descriptions illustrate the difficulties involved in adequately describing this complex. Not only are there rapid changes from one phase to the next both in mineralogy and texture, but various secondary alterations have locally effectively masked the original mineralogy of these rocks. Also while out-

crop exposure is locally abundant along the shore and islands of Sturgeon Narrows it is quite sparse in the eastern interior portion of this complex due to a thick cover of overburden and vegetation.

The contacts of this complex are approximately concordant to the foliation trends of its wallrocks although at the north end of Sturgeon Narrows its western contact is slightly discordant or else it is in fault contact with the wallrocks. The wallrocks are greenschist facies metavolcanics, metasediments, and minor mafic intrusive rocks.

The wallrocks locally show the effects of metasomatism, i.e. fenitization, due to mineralogical transformation caused by solutions generated within the alkalic system. Heinrich (1966, p.67) described a fenite thus:

> By fenite, accordingly is meant 'in situ' metasomatically altered (with or without substantial material exchange) older contacting rock irrespective of composition, but the term does not apply to mobilized (rheomorphic) and transported hybridic mixed rocks.

Fenitized portions of the wallrocks are visibly noticeable in places (in outcrop) by the development of pink or purple hues, by local 'bleached' areas, by the presence of veinlets and stringers of pink alkalic feldspar, and by the development of pyroxene-feldspar patches along joint-planes. In general, though, the wallrocks of the complex have been weakly fenitized, involving only minor modifications of the original mineral assemblages. Further effects of fenitization are discussed below under 'Fenitization'.

The author hypothesizes that intrusion of the Sturgeon Narrows Alkalic Complex was initiated by faulting/rifting that developed within a zone of metasediments or along a metasedimentary-metavolcanic contact. Subsequent erosion has stripped the metavolcanic-metasedimentary cover, exposing the present level of the alkalic complex. Although intrusion of the complex was initiated in a discordant structural zone, final emplacement tended to conform to the pre-existing regional structure. Evidence for the postulated fault zone along Sturgeon Narrows is: the slightly discordant relations the complex has to its wallrocks along its western margin; the aeromagnetic expression (ODM-GSC 1961) of this body, transgressive to the regional magnetic trend of the country rocks, especially along its western margin; and the presence in the metavolcanics on the west shore of Sturgeon Narrows of a series of steps and ledges trending parallel to Sturgeon Narrows. These steps and ledges have been interpreted by the author to be faults, and are suggestive of a structural emplacement of the Sturgeon Narrows Alkalic Complex possibly within an original graben-like structure.

These lineaments and faults may mark the site of an original fault or rift zone that initiated the Sturgeon Narrows Alkalic Complex, and along which the complex was intruded.

Penecontemporaneous (with intrusion), or later, fracturing of this complex is suggested by cataclastic effects observed in thin sections of the rocks of this complex and by breccia zones (which may in part be intrusive in origin) observed in outcrop in the southwestern portion of this complex.

The presence of carbonate dikes cutting the metavolcanics and metasediments along the Narrows and the local presence of carbonatized areas within the complex itself have led to speculation that this body might have associated intrusive carbonatite phases. Trace element and mineral identification of the carbonate from these dikes by the Mineral Research Branch, Ontario Division of

TABLE 3 | CHEMICAL ANALYSES AND NORMATIVE COMPOSITIONS OF ROCKS OF THE STURGEON NARROWS ALKALIC COMPLEX

Chemical Analyses in Weight Percent[1]

Sample Number	1-20-7	3-38-4	PL-1A	1-24-18	2-35-13	1-22-2	1-25-1
SiO_2	60.3	57.8	56.8	66.6	54.8	59.4	60.9
Al_2O_3	22.3	15.9	19.0	16.1	19.0	16.4	18.1
Fe_2O_3	2.27	5.32	3.19	2.13	3.41	3.05	2.82
FeO	0.28	0.63	0.77	1.32	1.95	1.39	2.09
MgO	0.42	0.08	0.40	0.85	1.52	1.12	2.29
CaO	1.16	6.63	1.86	2.01	3.09	3.24	2.19
Na_2O	4.07	6.80	8.25	5.26	8.64	6.62	6.07
K_2O	8.28	5.09	7.41	4.53	5.75	4.50	5.19
H_2O^+	0.80	0.62	1.63	0.63	1.39	0.54	0.53
H_2O^-	0.04	0.13	0.11	0.12	0.11	0.11	0.02
CO_2	0.70	0.28	0.96	1.25	0.72	3.52	0.16
TiO_2	0.30	0.75	0.38	0.38	0.41	0.57	0.52
P_2O_5	0.02	0.10	0.04	0.09	0.07	0.29	0.22
S	0.05	0.30	0.15	0.01	0.30	0.46	0.02
MnO	0.07	0.10	0.11	0.07	0.16	0.11	0.08
Total	101.1	100.5	101.1	101.4	101.3	101.3	101.2
Specific Gravity	2.66	2.68	2.56	2.69	2.61	2.55	2.65

Normative Compositions in Mole Percent

Quartz	1.692	-	-	12.757	-	-	-
Corundum	4.934	-	-	-	-	-	-
Orthoclase	48.394	29.745	42.647	26.753	32.747	26.721	29.873
Albite	36.110	39.099	24.817	47.155	18.059	54.461	53.086
Plag. Composition	An13.340	An0	An0	An12.801	An0	An3.001	An11.098
Anorthite	5.559	-	-	6.922	-	1.742	6.621
Nepheline	-	10.145	24.817	-	29.436	2.022	-
Acmite	-	3.450	8.652	-	6.060	-	-
Diopside	-	.436	2.149	1.861	8.081	6.209	1.855
Hedenbergite	-	-	-	.098	2.651	-	.187
Enstatite	1.146	-	1.120	1.413	-	-	.145
Ferrosilite	-	-	-	.074	-	-	.015
Forsterite	-	-	-	-	-	-	3.810
Fayalite	-	-	-	-	-	-	.385
Wollastonite	-	12.525	1.855	-	.363	1.893	-
Magnetite	.058	-	-	2.224	1.160	1.104	2.869
Ilmenite	.413	.605	.515	.529	.550	.797	.705
Pyrite	.129	.772	.380	.026	.752	1.203	.051
Hematite	1.525	2.801	-	-	-	1.398	-
Aptite	.041	.207	.081	.188	.141	.610	.448
Sodium Silicate	-	-	.895	-	-	-	-
Rutile	-	.214	-	-	-	-	-

1 *Analyses by Mineral Research Branch, Ontario Division of Mines.*

TABLE 3 *continued*

Sample Number	Latitude	Longitude	Description
1-20-7	49.939°	91.865°	Coarse-grained muscovite syenite (perthosite)
3-38-4	49.994°	90.712°	Medium-grained, approx. equigranular, garnet-nepheline syenite
PL-1A	49.961°	90.815°	Medium-grained, porphyritic, pyroxene-biotite-zeolite syenite
1-24-18	49.964°	90.815°	Medium-grained, porphyritic, chlorite-biotite syenite
2-35-13	49.801°	90.757°	Medium-grained, equigranular, aegerine-biotite-nepheline syenite
1-22-2	49.944°	90.858°	Coarse-grained, porphyritic, muscovite-biotite syenite
1-25-1	49.940°	90.851°	Medium-grained, equigranular, muscovite-pyroxene-biotite syenite

Mines, indicate that the carbonate is primarily dolomite and that it does not contain the trace element suite (specifically with regard to barium and strontium content) characteristic of carbonatites. Moreover, these dikes appear to fill tension (?) fractures possibly formed as a result of movement along the postulated fault zone. The coarse pegmatitic texture, lack of extensive fenite zone, and low grade metamorphism of its wallrocks all would suggest that the complex intruded the supracrustal rocks at a relatively high level, in contrast to the majority (there are exceptions) of carbonatite complexes. The presence of probable miarolitic cavities would suggest a hypabyssal origin. The associated rock suite is not characteristic of carbonatite complexes: specifically, an ijolitic rock suite (Heinrich 1966) is absent. It should be noted, however, that a strontium carbonate (strontianite) is reported to occur as narrow veinlets cutting the rocks of this complex (Drill hole information, Assessment Files Research Office, Ontario Division of Mines, Toronto;*see also* "W.G. Wahl Limited (21)" *under* "Description of Properties").

The alkalic complex locally exhibits flow banding (flow lamination) and compositional and textural layering. The large (coarse-grained to pegmatitic) generally perthitic potassic feldspar grains of the outer, coarse-grained, inequigranular syenite locally define a trachytoidal texture (Photo 4) in which the long dimensions of the feldspar grains are subparallel. This alignment of the feldspar grains, and in places the mafic minerals, has been interpreted by the author as an ex-

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Photo 4–Trachytoidal texture exhibited by coarse-grained, outer zone alkalic syenite of the Sturgeon Narrows Alkalic Complex. Pencil is oriented parallel to the approximate direction of alignment of feldspar grains. Alignment of feldspar grains is perhaps a reflection of primary flow lamination. Outcrop is located along east shore of Seaton Island.

pression of primary flow lamination. The few measurements obtained indicate that this flow lamination parallels the contact of the complex.

Compositional layering is marked by variations in the mafic content which produce mafic-rich and mafic-poor bands possibly reflecting a crystal settling of the mafic and feldspathic components.

A zonation which may represent layering is evidenced by grain size variations in a compositionally homogeneous unit, akin to graded bedding in sedimentary rocks. Determinations of the attitudes of the flow laminations and layered structures were, however, too sparse to arrive at any conclusions as to the exact mode of intrusion of this complex.

A further planar structure is defined by oriented mafic inclusions and bands observed mainly in the northeastern portion of the complex. The inclusions and bands probably represent remnants of the pre-existing country rocks which the complex has intruded. The original composition of these inclusions is uncertain but may have been gabbroic; they now are pyroxene-hornblende-biotite-plagioclase rocks. The trend of the inclusions and bands approximately parallels the foliation of the country rocks outside the complex indicating that intrusion was concordant in this area.

As mentioned previously, a cataclastic foliation has locally developed but was only observed in a few of the 30 thin sections examined. There appear to be two types of cataclastic deformation. (1) Microbreccia was observed in thin sec-

tion from rock samples along Sturgeon Narrows, and probably formed as a result of post-consolidation movement along the postulated fault zone. (2) In thin sections from the eastern and northern portions of the complex, fractures of a protoclastic nature appear to have formed by cataclasis caused by late intrusive movement within portions of the complex before complete crystallization.

The majority of the rocks of the alkalic complex, with local exceptions apparently due to alteration effects, are under-saturated with respect to silica and contain normative nepheline (Table 3). Their normative compositions are also characterized by consistently large amounts of sodic plagioclase and relatively low (generally less than 10 percent) amounts of total mafics.

Fenitization

The most intense areas of fenitization occur on Narrows Island, the shore north of this island and on Coveney Island (north of the map-area), while the most widespread effects of fenitization were observed along its eastern contact with mafic metavolcanic and associated mafic intrusive rocks.

On Narrows Island and the shore to the north of it, metasediments, including (chert-pebble) conglomerate and (feldspathic) greywacke, have been extensively altered. On the north shore, conglomerate (or pyroclastics?) have been transformed to a pink fine-grained feldspathic rock, the outline of clasts only being visible on weathered surface. On the island, perthite syenite porphyry and gieseckite (pseudomorphic after nepheline?) perthite syenite porphyry intruded the metasediments; some of the porphyry might be porphyritized metasediments. The greywackes are locally characterized by up to 25 percent replacement perthite.

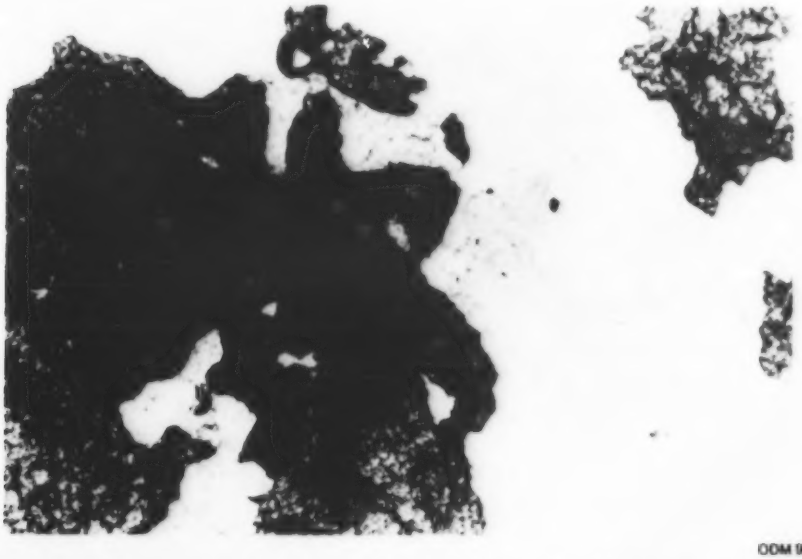
Along the eastern contact of the complex the effects of fenitization on the medium-grained subophitic metagabbroic country rocks include the development of blue-green (alkalic) amphibole rimming the original amphibole of these rocks, and the formation of clot-like aggregates of colourless (tremolitic) amphibole, minor pyroxene, garnet, and sphene. Even here, however, fenitization involves only minor metasomatism of the wallrocks, compared to other alkalic complexes (Heinrich 1966).

It is possible that along the south border of the complex, east of Sturgeon Narrows, a septum of metasediments and metavolcanics has been engulfed by the rocks of the complex. Outcrop exposure is poor, however, and the exact contact relationships could not be established.

Fenitization is also apparent on Seaton Island where the alkalic complex has intruded metavolcanics, mafic intrusive rocks and metasediments at the southwest end and metasediments at the northeast end. In the few thin sections examined from these two localities it appeared that no new minerals were developed and except for the development of a pink hue to the country rocks, the effects were minor. It should be kept in mind, however, that some of these units were so altered as to make them essentially indistinguishable from the alkalic complex itself.

ODM 9420

Photo 5–Coarse-grained, trachytoidal-textured syenite from Sturgeon Narrows Alkalic Complex that is cut by dikes of pink syenite and aplosyenite. Note subparallel alignment of feldspar grains which define the trachytoidal texture.



ODM 9421

Photo 6–Photomicrograph of inner zone garnet-nepheline syenite of Sturgeon Narrows Alkalic Complex. Large grain on left and smaller grain in upper right-hand corner of photo are andradite-type garnets. Large garnet contains inclusions of sphene and fluorite. Grey-white grain is orthoclase microperthite. Plane light, X.20.

Rock Classification of the Sturgeon Narrows Alkalic Complex

While the rocks of this complex are highly variable in appearance they can be assigned to four broad groupings on the basis of mineralogy, texture, and spatial distibution. These are: the outer syenites (Photo 5); the inner syenites (Photo 6); the inner leucosyenites which locally appear to intrude the inner syenites; and the eastern syenogabbro-syenodiorite zone.

The rocks can be classed as follows into two main groups: *feldspathoidal* with foids and essential feldspar; and *feldspathic* without foids.

Feldspathoidal	
Outer Syenite	Coarse grained to pegmatitic, inequigranular, locally trachytoidal, locally porphyritic, foid generally altered to zeolites.
Inner Syenite	Medium grained, equigranular to inequigranular, both foids and zeolites present.
Feldspathic	
Inner Leucosyenite	Pink, muscovitic, locally appears to intrude the feldspathoidal inner syenites, locally variable to leuco-monzonite.
Eastern Syenodiorite-Syenogabbro Zone	Syenogabbro, syenodiorite.

The principal foid, nepheline, which was apparently originally present both in the inner and outer syenites has suffered variable alteration which makes this two-fold grouping only approximate.

Further classification of these rocks, possible only by very detailed thin section work, could possibly be based on the distribution of those rocks in which the plagioclase component is contained within perthitic intergrowths, and the distribution of those rocks which contain significant interstitial plagioclase and antiperthitic intergrowths. Such a classification might consist of a potassium and a sodium-potassium series respectively.

OUTER SYENITE

The outer coarse-grained syenites generally consist of orthoclase and microcline microperthite, minor to no interstitial sodic plagioclase, augite-biotite aggregates, and various alteration products possibly representing original nepheline or other feldspathoids, and accessories. They are variably coloured from white to grey and locally are pink to red due to alteration. The feldspars are locally darkened, possibly by radioactivity (*see* 'Economic Geology') giving the rock a dark grey colour. The rocks vary in grain size from medium to very coarse, with the larger grain sizes predominant. They are generally massive though locally they exhibit primary flow lamination, and compositional and textural banding. Mafic content seldom exceeds 10 percent and consists of augite and au-

gite-biotite aggregates; the biotite characteristically is an alteration of the pyroxene.

INNER SYENITE

The inner, more medium-grained syenites consist of orthoclase and microcline microperthite, minor to major interstitial sodic plagioclase, major to no garnet (andradite-type) minor pyroxene (aegerine-augite) minor (primary) biotite and moderately altered nepheline. Generally they are slightly more leucocratic than the outer syenites.

INNER LEUCOSYENITE

The pink, muscovite syenite-monzonite consists of minor orthoclase perthite, major plagioclase and major sericitic aggregates.

Mineralogy

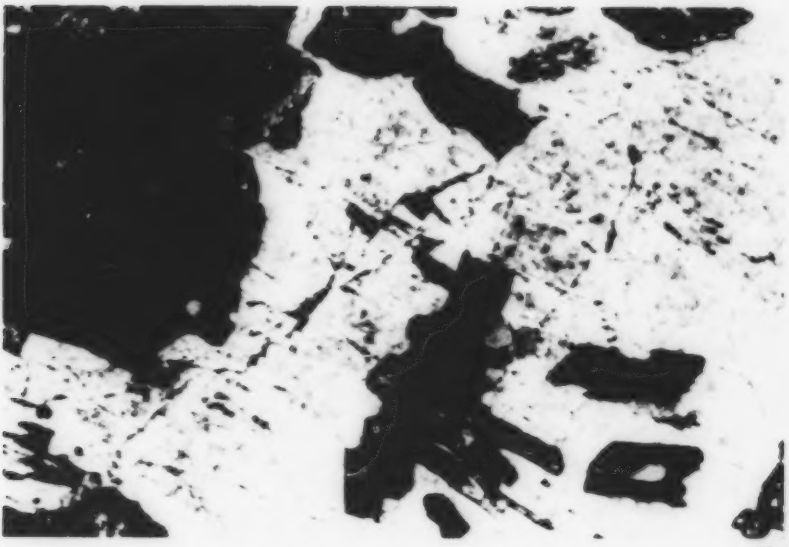
ESSENTIAL MINERALS

Alkali Feldspar. The alkali feldspar grains are subhedral to euhedral, generally elongate, simply twinned and perthitic. They vary from fresh to completely altered. Both orthoclase and microcline microperthite and local antiperthite are present.

Plagioclase. Plagioclase (sodic variety) occurs both as a constituent of perthite and as interstitial grains. It occurs in subhedral, fine to medium grains, and shows variable alteration. Locally it is replaced by scapolite. The plagiocalse appears to lie in the albite-oligoclase compositional range.

Nepheline. Nepheline is recognizable mainly in the central and northern portions of this complex although its former presence throughout most of the complex is indicated by assemblages of the alteration minerals discussed below. In hand specimen it is detected by subhexagonal pits on the weathered surface. In thin section it generally occurs as subhedral grains, often inclusion rich, and represented by zeolite pseudomorphs after nepheline. It invariably shows some degree of alteration. It varies in colour from pale green to grey to green locally to brown. It generally contains abundant subparallel inclusions.

Pyroxene. Pyroxene is the most common but not necessarily most abundant mafic mineral in the alkalic rocks. Based on limited thin section examination, the pale yellow-green pyroxene of the outer syenite seems to lie in the augite compositional range, whereas the darker green more noticeably pleochroic pyroxene of the central and northern portions of the complex appears to be of the aegerine-augite to aegerine variety. The habit of the pyroxene varies. In the



ODM 9422

Photo 7–Photomicrograph of inner zone garnet-nepheline syenite of Sturgeon Narrows Alkalic Complex. Grain in lower central position is subhedral aegerine-augite. Dark grain in top left-hand corner position is mixture of garnet and biotite. Large grey white grain is orthoclase microperthite. Crossed nicols. X.20.

outer zone it is invariably altered to biotite, occurring in anhedral shred-like clots and aggregates interstitial to the alkali feldspar whereas in the inner zone it is more euhedral, shows significant zonation, and occurs as single grains interstitial to the feldspar. The pyroxene in the inner zone appears to possibly have an antipathetical relationship to garnet.

Garnet. An andradite-type garnet is locally a major constituent of the inner nepheline syenite (Photo 7) which occupies the north-central portion of this complex. In hand specimen this garnet is seen as black to brown poorly developed dodecahedra. Its grain size varies from less than 12 mm to more than 2 cm. In nepheline syenite, it occurs as both an accessory mineral (less than 1 to 2 percent) and an esential mineral (5 to 10 percent); locally it makes up 15 percent of the rock, occurring in excess of nepheline with which it is invariably found. In thin section under plane light it varies in colour from pale yellow to brown to dark red-brown. It generally accompanies alkali feldspar, plagioclase, nepheline, sphene, and minor biotite. Garnet accompanying sphene in clotty aggregates was observed in the metagabbroic country rocks where it was interpreted to have been formed by fenitization. Garnet appears to have been a primary crystalizing phase. D.H. Watkinson of the Department of Geology, Carleton University, Ottawa, did an electron microprobe analysis of six garnets taken from a sample located approximately 3 km (2 miles) northeast of Anderson Lake. Table 4 gives the average chemical analysis of these garnets. During this study, Watkinson noted that individual garnet grains are compositionally zoned.

TABLE 4 | MICROPROBE ANALYSES OF GARNET FROM INNER NEPHELINE SYENITE OF THE STURGEON NARROWS ALKALIC COMPLEX. ANALYSES BY D.H. WATKINSON, CARLETON UNIVERSITY, OTTAWA.

Element	Garnet 1	Garnet 2	Garnet 3	Garnet 4	Garnet 5	Garnet 6	Average
Fe	29.75	31.57	27.37	28.59	27.83	27.98	28.83
Si	34.99	35.17	35.49	36.72	36.96	36.60	35.98
Ca	35.32	34.58	35.41	35.41	33.64	31.75	33.98
Al	1.98	1.37	1.83	3.23	4.15	6.34	2.45
Total	102.04	102.69	100.00	102.18	102.08	102.67	101.24

Ion	Numbers of Ions*	
Fe^{3+}	1.79	1.95
Al	0.16	
Al	0.03	3.00
Si	2.97	
Ca	3.02	3.02

* *Number of ions based on 12 oxygen (calculated from the average).*

ALTERATION MINERALS

The alteration minerals of what is assumed to have been nepheline are generally complex hydrous sodium silicates, most or all of which often occur together in the same rock. They include the following.

Natrolite. Natrolite is a member of the zeolite family. It occurs as a white to brown-white, fine-grained interstitial aggregate.

Analcite. Analcite is a secondary mineral possibly of deuteric origin. It occurs in interstitial powdery aggregates with sodalite and a micaceous mineral (gieseckite).

Sodalite. Sodalite is found accompanying cancrinite and gieseckite as an interstitial powdery alteration apparently after nepheline. It could also be a primary mineral.

Cancrinite. Cancrinite occurs in interstitial powdery aggregates. Cancrinite could be in part primary and in part secondary formed at the expense of feldspar

and nepheline by reaction with carbonate-rich solutions.

Hydronepheline. Hydronepheline is a variety of natrolite which occurs along with natrolite and analcite as an alteration of nepheline.

Gieseckite. Nepheline, in the outer zone especially, shows extensive alteration to fine-grained muscovite aggregates (gieseckite).

ACCESSORY MINERALS

Fluorite. Fluorite occurs as interstitial fine-grained disseminations and in sheared carbonatized zones, specifically on Narrows Island, on the shore to the north of this island and in diamond-drill core (*see* 'W.G. Wahl Limited (21)' *under* 'Description of Properties'). It is present throughout the entire complex in amounts generally less than 0.5 to 1 percent. Its colour is variable, both from locality to locality within an individual rock specimen, and locally within individual grains, from blue to pink to purple to colourless.

Apatite. Apatite is a ubiquitous mineral though generally it makes up less than 2 percent of the rock. It forms fine to medium ovoid grains or ovoid clusters, and is often accompanied by magnetite. It also occurs as inclusions in biotite and biotitized pyroxene.

Sphene. Sphene in euhedral, red-brown, fine grains is likewise ubiquitous in amounts less than 2 percent.

Biotite. Biotite occurs as an alteration of pyroxene in the outer zone, suggesting that water was retained during crystallization. Biotite was also a primary crytallizing phase in the inner zone. The biotite in the outer zone is generally brown whereas that in the inner zone tends to be green. Locally within the inner zone two types of biotite are present.

Hematite. Hematite locally occurs in fine-grained disseminations along Sturgeon Narrows both in the rocks of the alkalic complex and in the metasediments which it intrudes, and its formation was perhaps due to hydrothermal activity.

Scapolite. Scapolite locally occurs as anhedral to subhedral interstitial grains and may in part have been a primary crystallizing phase. It appears to be a calcium-rich scapolite on the basis of its distinctive yellow-violet interference colour. It was difficult in the field to distinguish between nepheline and scapolite because they weather similarly and because scapolite, like nepheline, alters readily by hydration to zeolites, hydronepheline, and micaceous aggregates.

Pyrite. Pyrite is locally present, in amounts of up to 3 or 4 percent, as fine, euhedral, interstitial grains.

Carbonate. Stained hand samples indicate that carbonates, both calcite and dolomite, are generally present as subhedral interstitial grains. Carbonate is very seldom present in amounts of more than 3 percent although locally such as along Sturgeon Narrows and on Seaton Island it comprises a substantial portion of the rock units.

Chlorite. Chlorite was locally observed as an alteration of the biotite in the rock units of this complex.

Quartz. Quartz was only locally present along Sturgeon Narrows and in most cases was probably of secondary origin.

Strontianite and Roscoelite. Strontianite (strontium carbonate) and roscoelite

(vanadium mica) were reported to be present in diamond-drill core from the W.G. Wahl Limited property (*see* 'Description of Properties').

Syenodiorite-Syenogabbro Zone

The rocks comprising the syenodiorite-syenogabbro zone underlie the northeastern portion of the Sturgeon Narrows Alkalic Complex and are lithologically distinct from the undersaturated alkalic syenite units described above.

The author is uncertain whether this zone predated the alkalic complex and represents an assemblage of mafic intrusive rocks including perhaps some minor mafic to intermediate volcanic rocks, all of which were metamorphosed and fenitized by the Sturgeon Narrows Alkalic Complex, or whether the zone represents an assemblage of mafic intrusive rocks that were cogenetic with the undersaturated alkalic suite of the Sturgeon Narrows Alkalic Complex. This second hypothesis is favoured by the author for the following reasons: the apparently primary unmetamorphosed mineralogy of these rocks, specifically the presence of clinopyroxene and calcic plagioclase and perhaps relict olivine; the intrusive texture of these rocks; and the local presence of mafic inclusions within these rocks. These mafic inclusions might in fact be relicts of a pre-existing assemblage of mafic to intermediate volcanic and mafic intrusive rocks into which the suite of mafic intrusive rocks under discussion were intruded.

If the mafic assemblage was in fact cogenetic to the undersaturated alkalic suite of the Sturgeon Narrows Alkalic Complex, then it probably intruded the complex prior to final consolidation, because the mafic assemblage shows distinctive signs of having been fenitized.

The following description is based on field observations and a study of three thin sections of rocks from this zone. The rocks are generally medium grained to coarse grained, equigranular to locally slightly porphyritic, and are massive to weakly foliated. They vary in color from grey to green to dark black-green; locally they have a slight pinkish tinge. Their mafic content varies from 20 to 70 percent and is composed of varying proportions of clinopyroxene, biotite, and amphibole. Essential pyroxene and biotite were present in all three thin sections, whereas amphibole occurred in minor amounts in two, replacing the pyroxene, and in the third occurring as an essential mineral. Pyroxene was the most abundant mafic mineral observed in all three thin sections.

Pyroxene occurs as subhedral to euhedral grains and exhibits light green to medium green pleochroism. It is a clinopyroxene, but its habit and pleochroism, and thus possibly its composition are different in all three thin sections. The amphibole, where it has replaced pyroxene, exhibits a pale green pleochroism, but where it is an essential mineral it occurs as subhedral grains exhibiting a dark green pleochroism with a light bluish tinge. In the two thin sections in which the amphibole has replaced the pyroxene, biotite occurs as anhedral ragged grains having a dark red-brown colour whereas in the third thin section containing essential amphibole, biotite occurs as subhedral dark olive-green grains.

Plagioclase occurs in all three thin sections. It is invariably altered to sericite but locally, remnant grains having a calcic composition are present. In one section taken from the western portion of this zone, two generations of plagioclase

are present: an older(?) calcic plagioclase now almost completely altered to sericite but locally exhibiting remnant cores having a calcic composition, and a younger(?) interstitial, fresh, sodic plagioclase. The formation of antiperthite and the presence of alkali feldspar are interpreted to be the result of potassic fenitization, although it is feasible that these syenogabbroic-syenodioritic rocks were slightly alkalic to begin with.

Accessory minerals include magnetite (2 to 5 percent), sphene, and apatite. The apatite occurs as inclusions in the dark red-brown biotite grains. Fluorite (less than 0.5 percent) occurs interstitially in one thin section taken from the western border of this zone. No feldspathoidal minerals were identified in the thin sections.

A coronitic or kelyphytic texture was observed in one thin section. In thin section the texture is defined by a central core of relict serpentine(?) containing abundant disseminated magnetite enclosed in successive layers of amphibole and biotite. The amphibole layer is characterized by variations in pleochroism suggesting a compositional zoning. Approximately 10 percent of the rock exhibited this texture. Some of these grains could have originally been olivine. This structure is interpreted to have been caused by reaction, probably in solid or semi-solid state, in the presence of an intergranular fluid.

The rocks of this zone are locally intruded by fine-grained dikes and veinlets of syenite and aplosyenite.

METAMORPHISM OF THE PRECAMBRIAN ROCKS

The metavolcanics, metasediments, and associated mafic intrusive rocks have been regionally metamorphosed under greenschist facies conditions. Except for relict textures and preserved primary mineralogy (for example, calcic plagioclase and uralitized pyroxene were observed in thin section to be locally present in the mafic intrusive rocks) the mineral assemblages of these rocks are a result of the regional metamorphism they have been subjected to.

Superimposed on this regional metamorphism are the contact metamorphic and metasomatic effects of the Sturgeon Narrows Alkalic Complex and the contact metamorphic effects of the Vista Lake Complex.

The metasomatic effects of the Sturgeon Narrows Alkalic Complex have been previously described under 'Fenitization'. The metamorphic effects of this complex are less noticeable but may be evidenced by the occurrence of what are referred to in the assessment files (submitted by Green Point Mines Limited—Consolidated Red Poplar Minerals Limited; *see under* 'Description of Properties') as 'skarn zones' within the metasediments near the contact with this intrusion.

The contact metamorphic effects of the Vista Lake Complex are evidenced by the mineral assemblages of the metasediments east of Quest Lake. Going east from Quest Lake greenschist facies minerals (chlorite, biotite, garnet) gradually give way to almandine amphibolite facies minerals (biotite, garnet, hornblende). Complicating this picture is the presence on the shore and just east of Quest Lake of a retrograde mineral assemblage characterized by aluminum silicates now represented by pseudomorphic aggregates of quartz, plagioclase, and white mica. It is possible that the intrusion of the Sturgeon Narrows Alkalic Complex

was responsible for the retrograde metamorphism of these metasediments but this hypothesis is only speculative because no age data exist for any of the intrusive complexes.

No metamorphic effects directly attributable to the intrusion of the mafic and ultramafic rocks were observed. Chlorite-tremolite assemblages in the ultramafic rocks suggest that the four bodies of ultramafic rocks were also metamorphosed under greenschist facies conditions.

Quaternary

PLEISTOCENE AND RECENT DEPOSITS

The Pleistocene deposits of the area are of glacial origin, whereas the Recent deposits comprise mainly beachsands, reworked gravels, and boulder accumulations along the present drainage system. Swamp and bog deposits are common throughout the area.

Eskers and esker-outwash complexes are relatively abundant in various parts of the map-area. They form sinuous ridges of sand, gravel, and boulders and show marked positive relief. These eskers generally trend in a southwesterly to south direction and probably paralleled the latest direction of ice movement.

Drumlinoid ridges composed of sandy boulder moraine generally trend parallel to the trend of the eskers.

Two directions of glacial striae were observed; the main set trends in a southwesterly direction while a second set observed along the south shore of Sturgeon Lake trended in a more southerly direction. It appears that the southerly trending set were cut by and are thus older than the southwesterly trending set.

STRUCTURAL GEOLOGY

FOLIATION AND SCHISTOSITY

The majority of the metavolcanics have a moderately to well developed metamorphic foliation defined by the subparallel alignment of mafic minerals (amphibole, biotite, chlorite), sericite and rock clasts.

The metasediments are commonly foliated, and the foliation trends subparallel to bedding. The felsic to intermediate metavolcanics in the Six Mile Lake area are locally highly schistose being now represented by sericitic schists.

Along Sturgeon Narrows both the metavolcanics and metasediments exhibit a schistosity developed at an angle to a previously developed foliation. The author has interpreted this schistosity as a second planar structure formed as the result of movement along a postulated fault zone along Sturgeon Narrows.

The mafic and ultramafic intrusive rocks are generally massive or possess only a weak foliation.

The Vista Lake Complex exhibits a foliation defined by the subparallel alignment of biotite and amphibole, or of chlorite which replaces them.

The Sturgeon Narrows Alkalic Complex locally exhibits a trachytoidal texture defined by the suparallel alignment of potassic feldspar crystals. This texture defines a planar structure, *sensu stricto* a lineation, that may reflect primary flow banding. The alignment of mafic inclusions in the northeastern portion of the body may define a primary or secondary planar structure.

GNEISSIC STRUCTURE

The Vista Lake Complex locally has a gneissic structure defined by the *lit-par-lit* arrangement of included metasedimentary bands. The gneissic structure exhibited in places by the intrusion itself may be a primary igneous structure.

LINEATION

Secondary lineations comprising the intersection of S-surfaces, minor fold axes, stretching of rock clasts and preferred alignment of minerals are relatively common in the metavolcanics and metasediments but are rare in the mafic intrusive rocks, rocks of the alkalic complex, and granitic rocks.

FAULTS

Few faults have been recognized in the map-area. This, however, is probably a direct reflection of the generally low outcrop density rather than absence of deformation.

As described previously under 'Sturgeon Narrows Alkalic Complex' there are a series of rock steps and ledges along and paralleling the west side of Sturgeon Narrows which the author has interpreted as being the surface expression of a series of step-faults. Also, parts of the east shore of Sturgeon Narrows define relatively sharp lineaments. The author believes that Sturgeon Narrows is a possible fault zone. Indirect evidence for possible movement along this zone is the development of a secondary schistosity formed at an angle to the pre-existing foliation in the metavolcanics on the west side of the narrows while direct evidence is afforded by recognition of the breccia zones within the rocks of the Sturgeon Narrows Alkalic Complex along Sturgeon Narrows.

A north trending fault with right-hand strike separation has been interpreted to the south of Sturgeon Lake, about 2 km (1 mile) west of Barge Lake to explain the configuration of the felsic to intermediate and mafic to intermediate metavolcanic assemblages respectively.

Other lineaments noted on the map might also represent faults.

FOLDING

The scarcity of minor fold structures and top directions, the lack of marker horizons, coupled with the fact that the critical outcrop areas are not exposed, make it difficult to decipher the regional fold pattern within the map-area. Stratigraphic correlation of the metavolcanic assemblages is hampered by the fact that they comprise contrasting lithologies and may be of different ages, as outlined below.

The area south of Sturgeon Lake (Trowell 1974a; 1974b) is underlain by a predominantly north-facing multicyclic metavolcanic assemblage, comprising rapidly alternating sequences of basalt, andesite, dacite, and rhyolite; whereas the area north of Sturgeon Lake is underlain, from north to south, by: a south-facing basaltic metavolcanic sequence, a south-facing sequence of pyroclastic, volcanic clastic[1] and autoclastic rocks of primarily dacitic composition, and a sequence of mafic and intermediate metavolcanics that face south in the north, and north where they are in contact with and apparently overlie the metasediments exposed on Sturgeon Lake. The author would suggest that because the relative age of the assemblages on either side of the lake is not known, the regional structure is synformal in nature.

With reference to the eastern portion of the map-area, the author has already suggested that the metavolcanic assemblage north of the Barge-Post-Add chain of lakes possibly overlies the metasedimentary sequences exposed along this chain of lakes as well as those in the Quest–Princess Lakes area. The present configuration of these assemblages may be a result of cross-folding whereby the metavolcanic assemblage acted as a buttress around and against which the metasedimentary sequences were squeezed.

CORRELATION OF GEOLOGY WITH AEROMAGNETIC DATA

The Quest Lake area was surveyed aeromagnetically in 1961, at a scale of 1:63,360 or 1 inch to 1 mile (ODM-GSC 1961).

The pronounced high magnetic response which trends approximately down the centre of the Barge-Post-Add chain of lakes is caused by oxide-facies iron formation of which there appear to be several discrete bands. The high magnetic response of the iron formation tends to overshadow any magnetic contrast between the adjacent metasediments and metavolcanics, and thus the contacts between these units are not readily apparent. Aeromagnetic highs associated with this belt of high magnetic response might also possibly be caused by mafic intrusive bodies in the immediate vicinity of the iron formation.

Similarly iron formation and/or mafic intrusive bodies are interpreted as being present down the centre of Sturgeon Lake.

The volcaniclastic conglomerate unit(s) on the shore and west of Princess Lake have a relatively high magnetic response apparently caused by significant

[1]On Map 2335, volcanic clastic rocks are included with the pyroclastic rocks of units 2a,2b, and 2c.

numbers of mafic metavolcanic and gabbroid cobbles and boulders within the conglomerate.

The bodies of serpenitinized peridotite located north of Barge and Post Lakes are indicated by areas of high magnetic response possessing elliptical configuration.

On the shore and north of Six Mile Lake the magnetic pattern is rather flat because the mafic intrusive bodies which intrude the felsic metavolcanic sequence contain little or no magnetite. South of the lake the mafic metavolcanics are indicated by a slight increase in magnetic response with respect to the area to the north.

The Sturgeon Narrows Alkalic Complex possesses a distinctive magnetic pattern. The outer portion of this body is outlined by a series of arcuate magnetic 'highs' while a magnetic 'low' overlies the central part. Its actual contacts with the country rocks, however, are not well defined by the aeromagnetic map.

The magnetic pattern over Sturgeon Narrows appears to transgress the trend of the magnetic pattern over the predominately metavolcanic sequence to the west. This configuration of magnetic patterns may be caused by a major structural zone which the author has previously suggested underlies Sturgeon Narrows.

There is a marked contrast in the magnetic responses of the Vista Lake Complex and the metasedimentary assemblage to the west, and thus, although the actual intrusive contact is a transitional zone marked by increasing metamorphic grade and accompanied by minor hybridization and migmatization, it is rather clearly defined on the aeromagnetic map.

ECONOMIC GEOLOGY

Intensive exploration has been conducted in the Quest Lake area since 1969 when the Exploration Division of Mattagami Lake Mines Limited discovered a base-metal (Zn, Cu, Ag, Pb) sulphide deposit (now mined by Mattabi Mines Limited) south of Sturgeon Lake just west of the boundary line between the Districts of Kenora and Thunder Bay.

Exploration activity was further heightened by two subsequent discoveries in 1970 and 1971. In 1970, Falconbridge Nickel Mines Limited discovered a base-metal sulphide deposit on their Lyon Lake property which they had optioned from New Brunswick Uranium Metals and Mining Limited. In 1971, the Exploration Division of Mattagami Lake Mines Limited discovered a base-metal sulphide deposit near Lyon Lake north of the Falconbridge Nickel Mines Limited discovery site.

No areas of economic mineralization were observed in the present map-area. Both the mafic to intermediate and felsic to intermediate metavolcanic assemblages generally contain minor amounts (1 to 2 percent) of sulphides, generally pyrite and pyrrhotite, locally with traces of chalcopyrite.

The metasedimentary assemblages also locally contain 1 to 2 percent sulphides.

The mafic intrusive rocks are generally barren or locally contain less than 1 to 2 percent disseminated sulphides. Several grab samples taken from these bodies by the field party and analyzed by the Mineral Research Branch, Ontario Di-

vision of Mines, gave only trace values of Cu, Pb, Zn, Ni and Co.

The ultramafic rocks are characterized by abundant magnetite locally accompanied by minor amounts of sulphides. Seventeen grab samples taken from these bodies were analyzed by the Mineral Research Branch, Ontario Division of Mines but showed only trace amounts of Cu, Zn, Ni, and Co.

Rogers (1964, p.45) reported finding traces of molybdenite as tiny disseminated flakes in a metasedimentary band enclosed within the Vista Lake Complex along the north shore of Vista Lake.

Disseminated fluorite mineralization was observed in all the rock units of the Sturgeon Narrows Alkalic Complex in amounts generally less than 0.5 to 1 percent. Local concentrations of fluorite were observed in carbonate shear zones on Narrows Island, on the shore north of this island, and in diamond-drill core from the W.G. Wahl Limited property, which core was briefly examined by the author (*see* 'Description of Properties').

Iron formation, presumably oxide facies, is aeromagnetically interpreted (ODM-GSC 1961) to extend along the approximate centre of Sturgeon Lake and down Barge and Post Lakes.

A narrow band of garnetiferous, magnetite, oxide-facies iron formation was observed interbedded in the metasedimentary assemblage east of Quest Lake. On the basis of aeromagnetic and ground magnetic information (*see* 'Description of Properties') other bands are likely present.

Sulphide iron formation was observed by the author in diamond-drill core from the Arctic Yellowknife Mines Limited property. It occurs in the metasedimentary assemblage north of Quest Lake.

Numerous bands of graphite, graphite + sulphide (generally pyrite, pyrrhotite), and sulphide horizons are reported in diamond-drill hole data turned in for assessment credit by several companies who have properties in the area (*see* 'Description of Properties'). These graphite + sulphide horizons are reported to occur in both metavolcanic and metasedimentary assemblages but are most common in intercalated assemblages of tuffs and metasediments which mark the transitional contacts between the metavolcanic and metasedimentary assemblages.

Rogers (1964) measured the radioactive response of both the Sturgeon Narrows Alkalic Complex and the Vista Lake Complex:

> Low radioactivity is associated with both the Sturgeon Lake alkaline syenite complex and the Vista Lake syenite. The Bell Lake syenite stock and associated contact rocks were not checked during the present survey because a systematic check of all the rock types in the area for radioactivity was not carried out. However, spot checks were made where possible, and no other areas of abnormal radioactivity were noted.

For a complete description of Rogers' study of radioactivity, the reader is referred to Geological Report 24 (Rogers 1964, p.42-44).

The author visited several of the same localities and found that the radioactive responses were essentially the same as reported by Rogers.

Rogers (1964, p.46) had several samples of the Sturgeon Narrows Alkalic Complex analysed for uranium and niobium.

No occurrences containing economic amounts of uranium were located. Samples from highly altered, radioactive contact rocks from the Sturgeon Lake syenite gave on analysis a U_3O_8 equivalent of 0.001-0.06 percent. Some of these samples of the radioactive contact rocks contain detectable amounts of thorium, cerium, and lanthanum.

Two of the samples containing 0.01 and 0.06 percent U_3O_8 equivalent also contain about 0.01 and 0.05 percent niobium, respectively. Although these values are low, [Rogers] believes they are significant enough to warrant detailed prospecting along the contacts of the Sturgeon Lake syenite.

All the samples of the Sturgeon Lake syenite and associated contact rocks were also tested by qualitative spectrographic analysis for the presence of beryllium. Only trace amounts (less than 0.005 percent) were found.

Description of Properties

Table 5 lists assessment information that has been submitted for the Quest Lake area up to the end of 1971. The table gives the file name, type of information, file number in the Assessment Files Research Office, Toronto, diamond-drill hole data, and date of work or file. Not all the diamond-drill holes are located on the map face because several could neither be located in the field nor could they be accurately located from the assessment files submitted.

AMALGAMATED BEAU-BELLE MINES LIMITED (1)

In 1971, Rio Tinto Canadian Exploration Limited held a group of 18 unsurveyed claims under option from Amalgamated Beau-Belle Mines Limited. The claim group is located east of Six Mile Lake.

In 1970, Rio Tinto Canadian Exploration Limited conducted ground magnetic, electromagnetic, and geological surveys over the property. As well, in 1970, they drilled two diamond-drill holes with a total length of 276.2 m (906.2 feet) on geophysical anomalies (Assessment Files Research Office, Ontario Division of Mines, Toronto). The diamond-drill holes intersected an assemblage of felsic to intermediate pyroclastics intruded by mafic intrusive rocks. Disseminated and stringer pyrite zones were observed within this pyroclastic assemblage by the field party.

The property is underlain by an assemblage of felsic to intermediate pyroclastics, predominantly lapilli tuff to lapillistone, flanked to the north and south by mafic to intermediate metavolcanic assemblages and the entire sequence appears to face south. Metagabbro and metadiorite bodies intrude the metavolcanics.

AMAX EXPLORATION, INCORPORATED (2)

In 1971, Amax Exploration, Incorporated held a group of 66 unsurveyed claims on the south shore of Sturgeon Lake. A portion of this claim group lies south of the present map-area.

In 1970, ground magnetic and electromagnetic surveys were conducted over the property.

TABLE 5 | LIST OF PROPERTIES AND ASSESSMENT WORK

FILE NAME	CLAIM MAP AREA	TYPE OF INFORMATION	TORONTO FILE NUMBER(S)	NUMBER OF DRILL HOLES AND FOOTAGE	DATE OF WORK OR FILE
Amalgamated Beau-Belle Mines Ltd. (Rio Tinto Canadian Explor. Ltd.)	Six Mile Lake	MAG, EM1, DD, GL	2.127	2-906'(276m)	1970-1971
Amax Explor., Inc.	Six Mile Lake	MAG, EM3, DD	2.157	3-1105'(337m)	1970-1971
Arctic Yellowknife Mines Ltd. (International Obaska Mines Ltd.)	Quest Lake	AGP, MAG, EM3 DD	2.428 2.208 2.209	5-2008'(612m)	1969-1971
Bordun Mining (Quebec) Ltd. *Bordun Mining Corp.	Six Mile Lake	MAG, EM3	2.693 63.2759		1970-1971
Conwest Explor. Co. Ltd.-Selco Explor. Co. Ltd.	Six Mile Lake	AMAG, AEM	2.500		1971
Conwest Explor. Co. Ltd.-Selco Explor. Co. Ltd.	Six Mile Lake	AMAG, AEM, DD	2.500	1-128'(39m)	1971
Conwest Explor. Co. Ltd.-Selco Explor. Co. Ltd.	Quest Lake	AMAG, AEM, MAG EM1, DD	2.500 2.738	5-572'(174m)	1971
D'Aragon Mines Ltd.	Six Mile Lake	MAG, EM3, DD	2.101	2-894'(272m)	1970-1971
Dome Explor. (Canada) Ltd.	Six Mile Lake	AMAG, AEM, MAG EM1	2.396 2.522		1971
Fanex Resources Ltd. *Fano Mining & Explor.Inc. (Chipman Mining and Energy Corp. Ltd.) *Chipman Lake Mines Ltd.	Six Mile Lake	MAG, EM2	2.134		1970
Green Point Mines Ltd.-Consolidated Red Poplar Minerals Ltd.	Six Mile Lake Quest Lake	AMAG, AEM, MAG EM3, DD	63.2729 2.416 2.766	11-2276'(694m)	1970-1971
Halren Mines Ltd. (Cons. Morrison Explor. Ltd.)	Quest Lake	MAG, EM3, DD	2.263	3-1154'(352m)	1970-1971

Hydra Explor. Ltd. (Rio Tinto Canadian Explor. Ltd.)	Six Mile Lake	MAG(2), EM1	63.2765		1970-1971
Jorex Ltd.	Quest Lake	AMAG, AEM	2.145		1970
Mattagami Lake Mines Ltd.	Six Mile Lake	MAG, EM3, DD	63.2779	2-1015'(309m)	1970
Mosher, Alex for Calmor Iron Bay Mines Ltd.-Selco Explor. Co. Ltd.	Six Mile Lake Quest Lake	MAG, EM2, AMAG, AEM, DD	2.213 2.467 2.982	13-3554'(1083m)	1970-1971
Noranda Mines Ltd.	Quest Lake	MAG, EM3, DD	2.183	5-2072'(632m)	1970-1971
Norlex Mines Ltd.	Six Mile Lake	AMAG, AEM, MAG EM3, DD	2.116 2.118 2.179	4-2211'(674m)	1969-1970
Pamike Mines Ltd. (Rio Tinto Canadian Explor. Ltd.)	Six Mile Lake	MAG, GL	2.661		1971
Spooner Mines and Oils Ltd.	Six Mile Lake	AMAG, AEM	2.58		1970
Texmont Mines Ltd.-Sturdy Mines Ltd.	Six Mile Lake	AMAG, AEM, MAG EM2, EM3	2.180 2.382		1970-1971
Toronado Mines Ltd. (Rio Tinto Canadian Explor. Ltd.)	Six Mile Lake	MAG, EM1, GL	2.144		1970-1971
Wahl, W.G. Ltd.	Six Mile Lake	MAG, DD	63.2437	7-5791'(1765m)	1968-1971
Western Quebec Mines Ltd.	Quest Lake	AMAG, AEM MAG, EM1, GL	2.426 2.594 2.674		1971

* *Indicates change in name*
() *Name in brackets holds option on property*

Abbreviations:

AEM	*- Airborne Electromagnetic*	*EM*	*- Electromagnetic*
AGP	*- Airborne Geophysics*	*GL*	*- Geological*
AMAG	*- Airborne Magnetic*	*MAG*	*- Magnetic, Magnetometer*
DD (2-2000')	*- Diamond Drilling, two holes, 2,000 feet*[1]	*EM*	*- Electromagnetic*
		EM1	*- Horizontal loop*
		EM2	*- Vertical loop*
		EM3	*- VLF*

[1] *Not all diamond drill holes are shown on map face.*

In 1971, three diamond-drill holes with a total length of 336.8 m (1,105 feet) were drilled on the property (Assessment Files Research Office, Ontario Division of Mines, Toronto). The diamond-drill holes intersected felsic to intermediate pyroclastics, mafic to intermediate metavolcanics, and mafic intrusive rocks. Within the felsic to intermediate pyroclastics graphite schist ± sulphide (mainly pyrite with minor pyrrhotite and in one hole chalcopyrite) horizons were intersected.

That portion of the property that lies within the present map-area is underlain by an assemblage of mafic to intermediate metavolcanics to the south and felsic to intermediate, predominantly pyroclastic rocks to the north. Tops are apparently to the north in this area. The felsic to intermediate metavolcanics are intercalated with metasediments towards the top of the assemblage. Graphite stringers occur in outcrops of these felsic to intermediate metavolcanics.

ARCTIC YELLOWKNIFE MINES LIMITED (3)

In 1971, International Obaska Mines Limited held a group of 35 unsurveyed claims under option from Arctic Yellowknife Mines Limited; the claims were held in the name of Ross Kidd for the benefit of Arctic Yellowknife Mines Limited. The property is located north of Quest Lake.

In 1969, Arctic Yellowknife Mines Limited carried out an airborne geophysical survey over the property.

In 1970, International Obaska Mines Limited conducted ground magnetic and electromagnetic surveys over the property.

In 1971, five diamond-drill holes with a total length of 511.7 m (2,007 feet) were drilled (Assessment Files Research Office, Ontario Division of Mines, Toronto). They intersected a predominantly metasedimentary assemblage with minor mafic metavolcanics and mafic intrusive rocks. Graphite ± sulphide zones occur locally within the metasediments.

The property is underlain by a metasedimentary assemblage intruded by metagabbro sills.

BORDUN MINING (QUEBEC) LIMITED (4)

In 1971, Bordun Mining (Quebec) Limited held a group of eight claims east of the north end of Six Mile Lake.

In 1970, Bordun Mining Corporation Limited carried out ground magnetic and electromagnetic surveys over the property.

In 1971, Bordun Mining (Quebec) Limited purchased Bordun Mining Corporation Limited. Subsequently in 1971, they carried out geophysical surveys over the property.

Very little outcrop occurs on this property. The eastern portion of the property is apparently underlain by mafic intrusive rocks.

CONWEST EXPLORATION COMPANY LIMITED–SELCO EXPLORATION COMPANY LIMITED (5)

In 1971, Conwest Exploration Company Limited, on a 50-50 basis with Selco Exploration Company Limited held three groups of unsurveyed claims: west of Sturgeon Narrows (13 claims), east of Sturgeon Narrows (96 claims), and northeast of Quest Lake (24 claims).

In 1971, an airborne magnetic and electromagnetic survey was conducted over the claim groups. Also in 1971, ground magnetic and electromagnetic surveys were carried out over the property east of Princess Lake.

In 1971, one diamond-drill hole with a total length of 39.0 m (128 feet) was drilled on the property east of Sturgeon Narrows (Assessment Files Research Office, Ontario Division of Mines, Toronto). Intermediate pyroclastics locally containing minor pyrite and pyrrhotite mineralization were intersected.

The property east of Sturgeon Narrows is underlain predominantly by mafic to intermediate metavolcanics and mafic intrusive rocks, and in the western portion of the property by the Sturgeon Narrows Alkalic Complex.

In 1971, five diamond-drill holes with a total length of 174 m (572 feet) were drilled on the property northeast of Quest Lake (Assessment Files Research Office, Ontario Division of Mines, Toronto). An assemblage consisting predominantly of metasediments locally cut by mafic intrusive rocks was intersected. Skarn zones and sulphide (pyrite, pyrrhotite) horizons were intersected.

The property northeast of Quest Lake is underlain by a predominantly metasedimentary assemblage.

The property west of Sturgeon Narrows is underlain by felsic to intermediate pyroclastic rocks cut by mafic intrusive bodies.

D'ARAGON MINES LIMITED (6)

In 1971, D'Aragon Mines Limited held a group of 40 unsurveyed claims west of Quest Lake. A portion of the claim group lies to the south of the present map-area.

In 1970, ground magnetic and electromagnetic surveys were carried out over the property.

In 1971, two diamond-drill holes with a total length of 272 m (894 feet) were drilled on the property (Assessment Files Research Office, Ontario Div. Mines, Toronto). The drilling intersected an assemblage of predominantly felsic to intermediate pyroclastics, minor mafic pyroclastics and flows, and graphitic schist horizons locally accompanied by sulphides (pyrite and pyrrhotite).

The portion of the claim group that lies within the present map-area is underlain by an assemblage of mafic to intermediate metavolcanics to the south and an assemblage of felsic to intermediate pyroclastics to the north. Tops in this area are apparently to the north (*see* Trowell 1974b).

DOME EXPLORATION (CANADA) LIMITED (7)

In 1971, Dome Exploration (Canada) Limited held two groups of unsurveyed claims west (18 claims) and east (15 claims) of the northern portion of Six Mile Lake.

In 1970, both airborne and ground magnetic and electromagnetic surveys were conducted over the property.

Both properties appear to be underlain predominantly by felsic to intermediate metavolcanics locally cut by mafic intrusive rocks.

FANO MINING AND EXPLORATION INCORPORATED (8)

In 1971, Fano Mining and Exploration Incorporated (now Fanex Resources Limited) held a group of 30 unsurveyed claims north of Six Mile Lake. A portion of the claim group lies to the north of the present map-area. In 1970, these claims were optioned to Chipman Lake Mines Limited which was acquired in 1971 by Chipman Mining and Energy Corporation Limited.

In 1970, ground magnetic and electromagnetic surveys were conducted over the property.

The property is underlain by an assemblage of felsic to intermediate metavolcanics intruded by mafic intrusive rocks.

GREEN POINT MINES LIMITED—CONSOLIDATED RED POPLAR MINERALS LIMITED (9)

In 1971, Green Point Mines Limited and Consolidated Red Poplar Minerals Limited held a group of 60 unsurveyed claims over and east and west of the northern end of Sturgeon Narrows.

In 1970, airborne magnetic and electromagnetic surveys were carried out over the property, and in 1971, these were followed by ground magnetic and electromagnetic surveys.

In 1971, six diamond-drill holes with a total length of 521.8 m (1,712 feet) were drilled west of Sturgeon Narrows (Assessment Files Research Office, Ontario Division of Mines, Toronto). A mixed assemblage of mafic to intermediate and felsic to intermediate metavolcanics was intersected. Local sulphide sections consisting of pyrite and pyrrhotite and trace chalcopyrite were also intersected.

In 1971, five diamond-drill holes with a total length of 172 m (564 feet) were drilled on the east side of the narrows south of Anderson Lake (Assessment Files Research Office, Ontario Division of Mines, Toronto). The diamond-drill holes intersected mainly metasediments and hornfelsed metasediments, and skarn and tactite zones, indicating that the metasedimentary units perhaps extend further west than mapped by the author.

The property is underlain on the west side of Sturgeon Narrows by an intercalated assemblage of mafic to intermediate and felsic to intermediate metavol-

canics, and minor metasediments, and is cut by minor mafic intrusive rocks. The eastern portion of the property is underlain by a portion of the Sturgeon Narrows Alkalic Complex and by the contact zone of this complex with a predominantly metasedimentary assemblage fenitized by the alkalic complex.

HALREN MINES LIMITED (10)

In 1971, Halren Mines Limited held a group of 30 unsurveyed claims east of Quest Lake. In 1970, Halren Mines Limited conducted ground magnetic and electromagnetic surveys over the property. These claims were optioned in 1971 to Consolidated Morrison Explorations Limited.

In 1971, Consolidated Morrison Explorations Limited drilled three diamond-drill holes with a total length of 353.3 m (1,159 feet) (Assessment Files Research Office, Ontraio Division of Mines, Toronto). An assemblage predominantly composed of metasediments with possible minor mafic metavolcanics was intersected. Zones of pyrite-pyrrhotite and of graphite and pyrite were intersected within the metasedimentary assemblage.

The claim group is underlain by a metasedimentary assemblage locally cut by mafic intrusive rocks. A thin band of quartz-magnetite oxide facies iron formation occurs interbedded within this assemblage.

HYDRA EXPLORATIONS LIMITED (11)

In 1971, Rio Tinto Canadian Exploration Limited held a group of 18 unsurveyed claims under option from Hydra Explorations Limited. The property is located north of Six Mile Lake.

In 1970, Hydra Explorations Limited carried out ground magnetic and electromagnetic surveys over the property.

In 1971, Rio Tinto Canadian Exploration Limited conducted a ground magnetic survey over the property.

The property is underlain by an assemblage of felsic to intermediate pyroclastic rocks extensively intruded by mafic intrusive and porphyritic felsic rocks.

JOREX LIMITED (12)

In 1971, Jorex Limited held a group of 33 unsurveyed claims on and south of Quest Lake. A portion of the claim group lies to the south of the present map-area.

In 1970, airborne magnetic and electromagnetic surveys were carried out over the property.

The portion of the property that lies within the present map-area is underlain predominantly by mafic to intermediate metavolcanics locally intruded by mafic intrusive rocks. Minor metasediments underlie the eastern portion of the property.

MATTAGAMI LAKE MINES LIMITED (13)

In 1971, Mattagami Lake Mines Limited held a group of nine unsurveyed claims on Sturgeon Narrows.

In 1970, ground magnetic and electromagnetic surveys were carried out over the property.

Also in 1970, two diamond-drill holes with a total length of 309.4 m (1,015 feet) were drilled (Assessment Files Research Office, Ontario Division of Mines, Toronto). The holes intersected an assemblage of intercalated intermediate and felsic pyroclastics with local graphitic tuff and sulphide zones containing pyrite, pyrrhotite, and minor arsenopyrite and sphalerite.

The property is underlain by felsic to intermediate, predominantly pyroclastic rocks, locally intercalated with minor mafic to intermediate metavolcanics.

ALEX MOSHER (14)

In 1971, Alex Mosher (Selco Exploration Company Limited and Calmor Iron Bay Mines Limited) held a group of 271 unsurveyed claims northeast of Post Lake. In 1970, Kennco Explorations (Canada) Limited held a portion (52 claims) of this property under option from L. Scott, G. Huston, and G. Potter.

In 1970, a ground magnetic and electromagnetic survey was carried out over the 52 claims comprising the Kennco Explorations (Canada) Limited option.

In 1971, an airborne magnetic and electromagnetic survey was carried out over the Mosher property.

In 1970, nine diamond-drill holes with a total length of 1083 m (3,554 feet) were drilled on the Kennco Explorations (Canada) Limited option (Assessment Files Research Office, Ontario Division of Mines, Toronto). These holes intersected a mixed assemblage comprising mafic volcanic flows, intermediate pyroclastics, intercalated tuffs and sediments, local chert bands and quartz-sericite phyllites. Zones of graphitic tuff + sulphides, and chert + sulphides were also intersected. The sulphides consisted predominantly of pyrrhotite and pyrite locally with traces of chalcopyrite.

In 1971, Selco Exploration Company Limited, drilled four diamond-drill holes with a total length of 214.1 m (702.5 feet) which intersected a mixed assemblage of intermediate pyroclastics, metasediments, mafic metavolcanics, and narrow sulphide zones comprising pyrite, pyrrhotite, minor chalcopyrite and locally trace amounts of sphalerite.

The property is underlain by mafic to intermediate and felsic to intermediate metavolcanics intruded by mafic intrusive rocks and by ultramafic (serpentinized peridotite) bodies.

NORANDA MINES LIMITED (15)

In 1971, Noranda Mines Limited held a group of 35 unsurveyed claims west of Princess Lake.

In 1970, ground magnetic and electromagnetic surveys were conducted over this property.

In 1971, five diamond-drill holes with a total length of 631.5 m (2,072 feet) were drilled on this property to investigate the anomalies picked up in the previous geophysical surveys (Assessment Files Research Office, Ontario Division of Mines, Toronto). The diamond-drill holes were reported to intersect felsic to intermediate metavolcanics, mafic to intermediate metavolcanics, mafic intrusive rocks, and some metasediments. Pyrite and pyrrhotite sulphide zones and carbonaceous tuffite horizons intersected during the drilling are believed to be the cause of the anomalies.

The author believes that most of the property is underlain by a predominantly metasedimentary assemblage rather than felsic to intermediate metavolcanics as appears evident from the diamond-drill hole information. However, in the western portion of the property, the metasediments either grade into, or are overlain by metavolcanics.

NORLEX MINES LIMITED (16)

In 1971, Norlex Mines Limited held a group of 54 unsurveyed claims west of Barge and Post Lakes. These claims were purchased from E.O. Dearden and L.K. Smith in October, 1969. A portion of the claim group lies to the south of the present map-area.

In 1969, airborne magnetic and electromagnetic surveys were conducted over the property in affiliation with Canadian Javelin Limited and Bison Petroleum and Minerals Limited. Also in 1969, ground magnetic and electromagnetic surveys were carried out over the property.

In 1970, four diamond-drill holes with a total length of 673.8 m (2,210.5 feet) were drilled on that portion of the property within the present map-area (Assessment Files Research Office, Ontario Division of Mines, Toronto). The holes intersected an alternating assemblage of felsic to intermediate pyroclastic rocks, silicified pyroclastic rocks, minor metasediments, and graphite $\pm$ sulphide zones.

Outcrop exposure is poor over the property and the only rock types observed were: mafic to intermediate metavolcanics, minor metasediments and mafic and ultramafic intrusive rocks.

PAMIKE MINES LIMITED (17)

In 1971, Rio Tinto Canadian Exploration Limited held a group of 44 unsurveyed claims under option from Pamike Mines Limited. The property is located on and west of Six Mile Lake.

In 1971, ground magnetic and geological surveys were conducted over the property.

The property is underlain predominantly by an assemblage of felsic to intermediate pyroclastic and autoclastic rocks which have been extensively intruded by irregularly shaped bodies of mafic intrusive and porphyritic felsic rocks.

SPOONER MINES AND OILS LIMITED (18)

In 1971, Spooner Mines and Oils Limited held a group of 227 unsurveyed claims on Sturgeon Lake, a portion of which lie outside the present map-area.

In 1970, airborne, magnetic and electromagentic surveys were conducted over the claim group.

The property is underlain by an assemblage of mafic to intermediate metavolcanics which are transitional to and partially overlain by a metasedimentary assemblage that extends along Sturgeon Lake and underlies the southern portion of the property.

TEXMONT MINES LIMITED–STURDY MINES LIMITED (19)

In 1971, Texmont Mines Limited and Sturdy Mines Limited held a group of 72 unsurveyed claims at the south end of Sturgeon Narrows.

In 1970, ground magnetic and electromagnetic surveys were conducted over the property. In 1971, airborne magnetic and electromagnetic surveys were carried out over the property.

The property is underlain by mafic to intermediate metavolcanics and intercalated metasediments which have been intruded by the Sturgeon Narrows Alkalic Complex and by ultramafic (serpentinized peridotite) intrusive rocks.

TORONADO MINES LIMITED (20)

In 1971, Rio Tinto Canadian Exploration Limited held a group of 137 unsurveyed claims under option from Toronado Mines Limited. The claim group is located on and south of Six Mile Lake.

In 1970, ground magnetic, electromagnetic, and geological surveys were conducted over the property.

The northern portion of the property is underlain by an assemblage of felsic to intermediate, predominantly pyroclastic and autoclastic rocks extensively intruded by mafic intrusive and porphyritic felsic intrusive rocks. The southern portion of the property is underlain predominantly by a mafic to intermediate metavolcanic assemblage which stratigraphically overlies the felsic to intermediate metavolcanic assemblage.

W.G. WAHL LIMITED (21)

In 1971, W.G. Wahl Limited held a group of 16 unsurveyed claims along Sturgeon Narrows.

In 1968, ground magnetic surveys were carried out over the property.

In 1969, five diamond-drill holes, with a total length of 1322 m (4,336 feet) were drilled (Assessment Files Research Office, Ontario Division of Mines, To-

ronto). Subsequently in 1970, Selco Exploration Company Limited drilled two holes for a total length of 443.5 m (1,455 feet) on the property (Assessment Files Research Office, Ontario Division of Mines, Toronto).

The five diamond-drill holes of 1969 intersected rock units of the Sturgeon Narrows Alkalic Complex and a mixed assemblage of intermediate metavolcanics and metasediments intruded by the complex. Fluorite mineralization, minor strontianite (strontium carbonate) and roecoelite (vanadium mica) were reported to be present (Assessment Files Research Office, Ontario Division of Mines, Toronto). Sulphides and local anomalous gold values were also reported. Mylonite zones intersected by the drilling were interpreted by Wahl as being the result of block faulting which bordered a graben structure extending down Sturgeon Narrows. The two diamond-drill holes of 1970 intersected a mixed assemblage of felsic to intermediate pyroclastic rocks, argillaceous metasediments and graphitic tuff ± pyrite zones.

The property is underlain by an assemblage of metasediments and some intermixed pyroclastic rocks which have all been intruded by and subsequently fenitized by the Sturgeon Narrows Alkalic Complex. Disseminated fluorite mineralization occurs in the alkalic rocks. As well, local sheared and carbonatized zones contain more massive pods of fluorite.

WESTERN QUEBEC MINES LIMITED (22)

In 1971, Western Quebec Mines Limited held a group of eight claims along the north boundary of the map-area.

In 1971, air and ground magnetic and electromagnetic surveys were carried out over the property.

The property is underlain predominantly by greywacke and siltstone-argillite metasediments and by syenogabbro and syenodiorite phases of the Sturgeon Narrows Alkalic Complex.

Considerations in Future Exploration

No definite indications of economic mineralization were discovered during the course of mapping the report-area; however, the presence of significant accumulations of intermediate to locally felsic, pyroclastic, autoclastic, and volcanic clastic[1] rocks in the Six Mile Lake area and northeast of Post Lake perhaps warrant further investigation. Sulphide mineralization, though not extensive, has been reported from both these areas. Exploration in these areas should perhaps be concerned with those units which comprise unworked pyroclastic and/or proximal facies volcanic clastic rocks. Several other suggestions which may assist in planning mineral exploration in the map-area are outlined below.

Fluorite, generally in amounts less than 1 percent, occurs disseminated throughout the Sturgeon Narrows Alkalic Complex. Concentrations of fluorite

[1]On Map 2335, volcanic clastic rocks are included with the pyroclastic rocks of units 2a,b,c.

were observed on Narrows Island and on the shore to the north; at both locations it occurs in carbonatized shears. Fluorite veinlets and local zones of strontianite were observed in diamond-drill core from a hole drilled on the western shore of Sturgeon Narrows (*see* 'W.G. Wahl Limited (21)' *in* 'Description of Properties').

The four ultramafic bodies located north of Post and Barge Lakes are worthy of consideration if only because such a small proportion of their interpreted extent is exposed and consequently the intrusions have not been explored to any great extent. Abundant magnetite and pyrrhotite were observed in these bodies. A detailed chemical study (analysis of outcrop and drill-core specimens) of these bodies, specifically concentrating upon their elemental abundances of Ni, Co, Cu and S might, however, give some indications as to the possibility of economic sulphide mineralization associated with them.

Both the mafic and intermediate extrusive rocks and the mafic intrusive bodies seem to contain only minor (1 to 2 percent) amounts of sulphides.

No significant thickness of iron formation was observed in the course of mapping, however, diamond-drill core and geophysical information indicate that in unexposed areas iron formation, especially of the sulphide facies, is common though individual units are apparently thin (less than 0.3 to 1.5 m or 1 foot to 5 feet) and discontinuous. Although the oxide-facies iron formation which extends along the centre of Sturgeon Lake and along the Barge-Post-Add chain of lakes has not been tested by diamond drilling it does possess a very strong magnetic response. Exploration in those areas where sulphide-facies iron formation is present should concentrate on their stratigraphic position within the volcanic assemblage so as to outline favourable stratigraphy for possible economic sulphide mineralization.

Quartz veins cut the metavolcanics but those which have been examined are generally barren or contain only trace amounts of gold.

The base-metal sulphide deposits (Zn, Cu, Ag, Pb) in the Sturgeon Lake area are found in association with siliceous pyroclastic rocks at or near the contact with overlying mafic and intermediate metavolcanics. Similar intermediate to locally felsic pyroclastic and autoclastic rocks were mapped in the present map-area, but the assemblages in which they occur do not appear to correlate stratigraphically with the assemblage south of Sturgeon Lake.

The author believes, therefore, that in exploration, the areas north of Sturgeon Lake and north of the Barge-Post-Add chain of lakes should be examined on their own merit rather than upon attempts at direct correlation with the assemblage located south of Sturgeon Lake. The Mattabi Mines Limited orebody has a footwall alteration zone characterized by the presence of chloritoid, carbonate, chlorite, kyanite-andalusite etc. No marked zones of wallrock alteration were observed during the course of mapping this area although they could be easily missed.

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